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RESTRICTED

WAR DEPARTMENT

U.S. Dept. of Army
TECHNICAL MANUAL

~~III~~
LIGHT
CARGO CARRIER T-15

FEBRUARY 5, 1943

RESTRICTED

TECHNICAL MANUAL
No. 9-893WAR DEPARTMENT
Washington, February 5, 1943

LIGHT CARGO CARRIER T-15

Prepared under the direction of the
Chief of Ordnance
(with the cooperation of the Studebaker Corporation)

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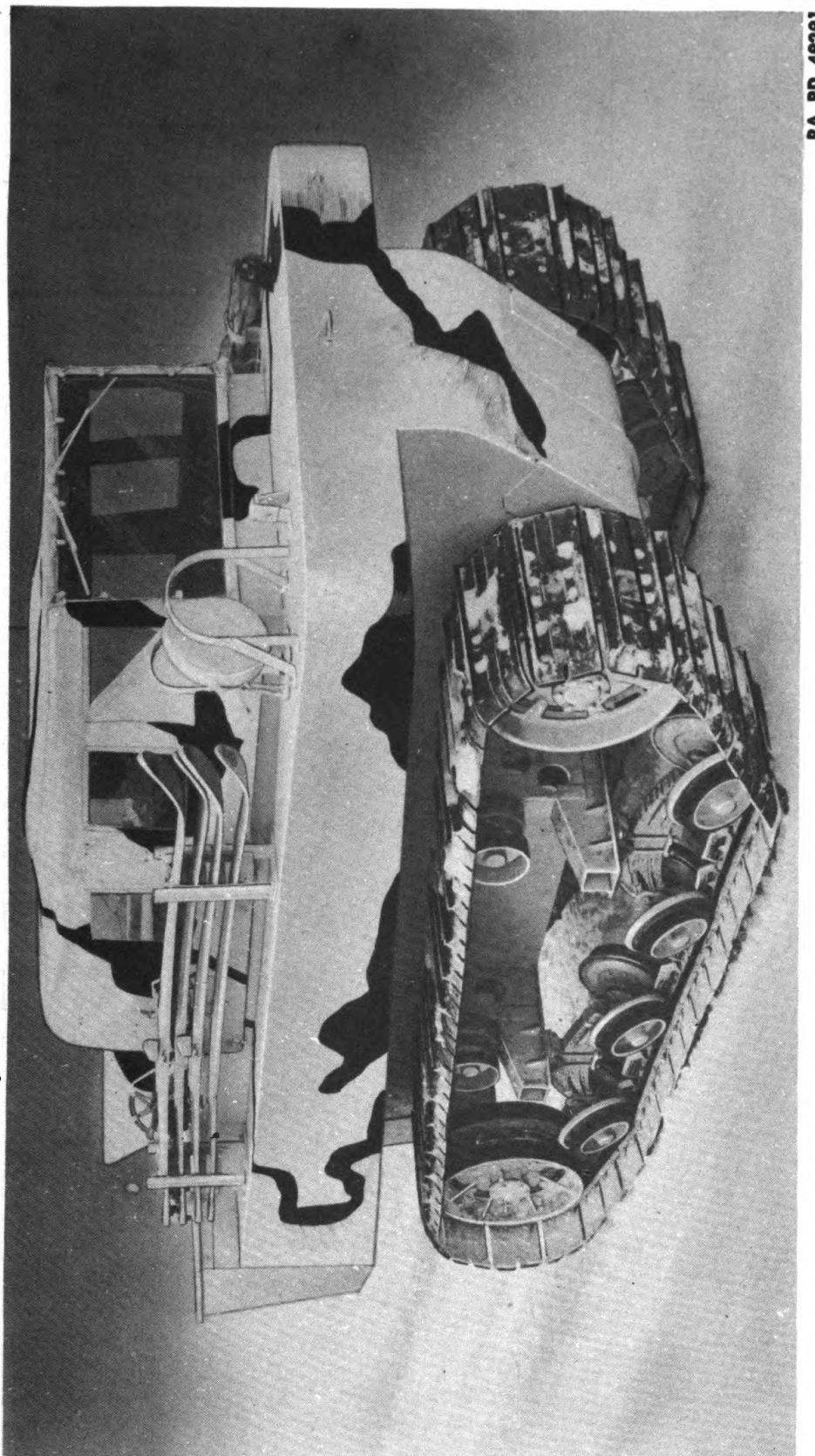
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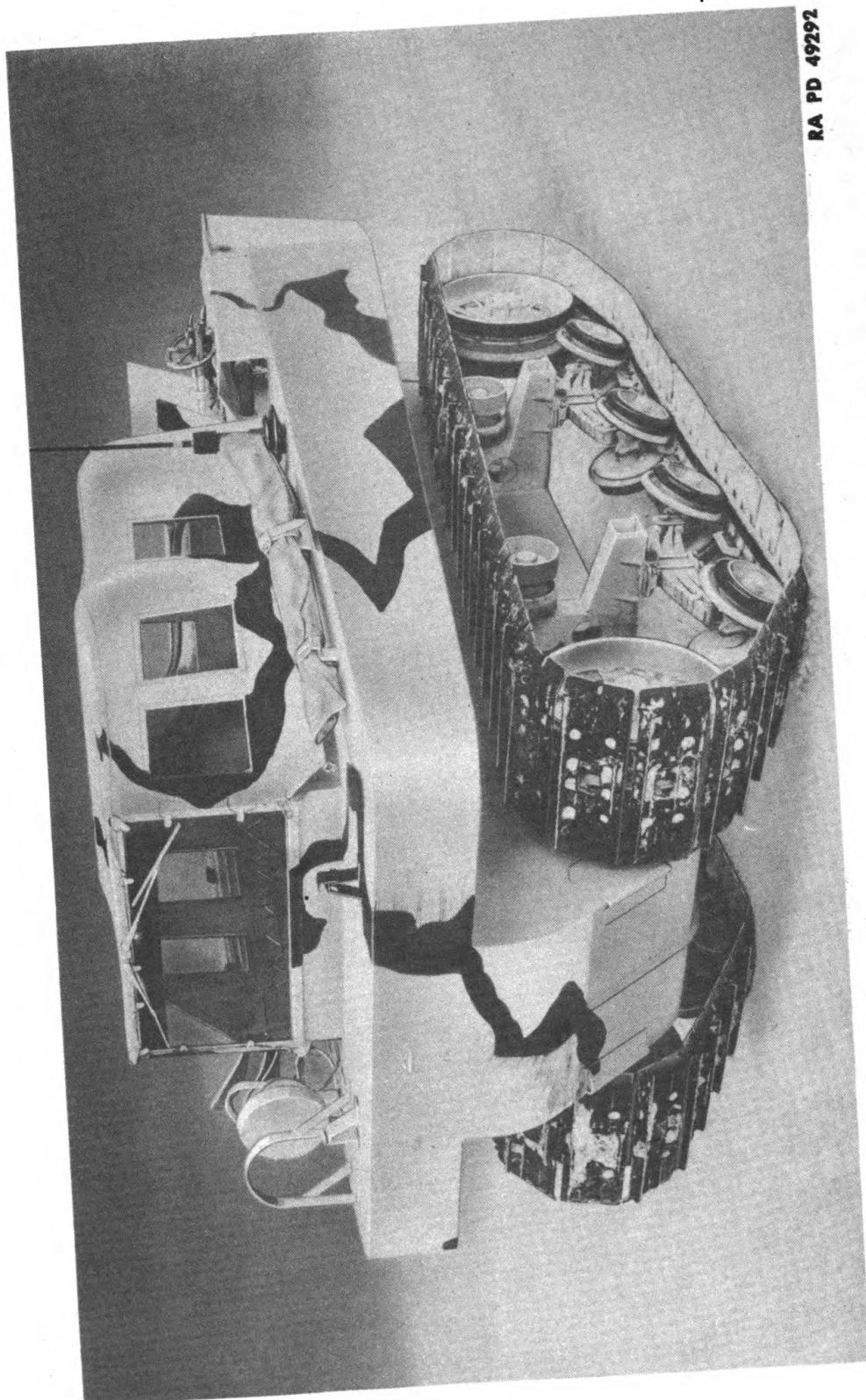
LIGHT CARGO CARRIER T-15



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Figure 1—Light Cargo Carrier T-15—Right Three-quarter Front

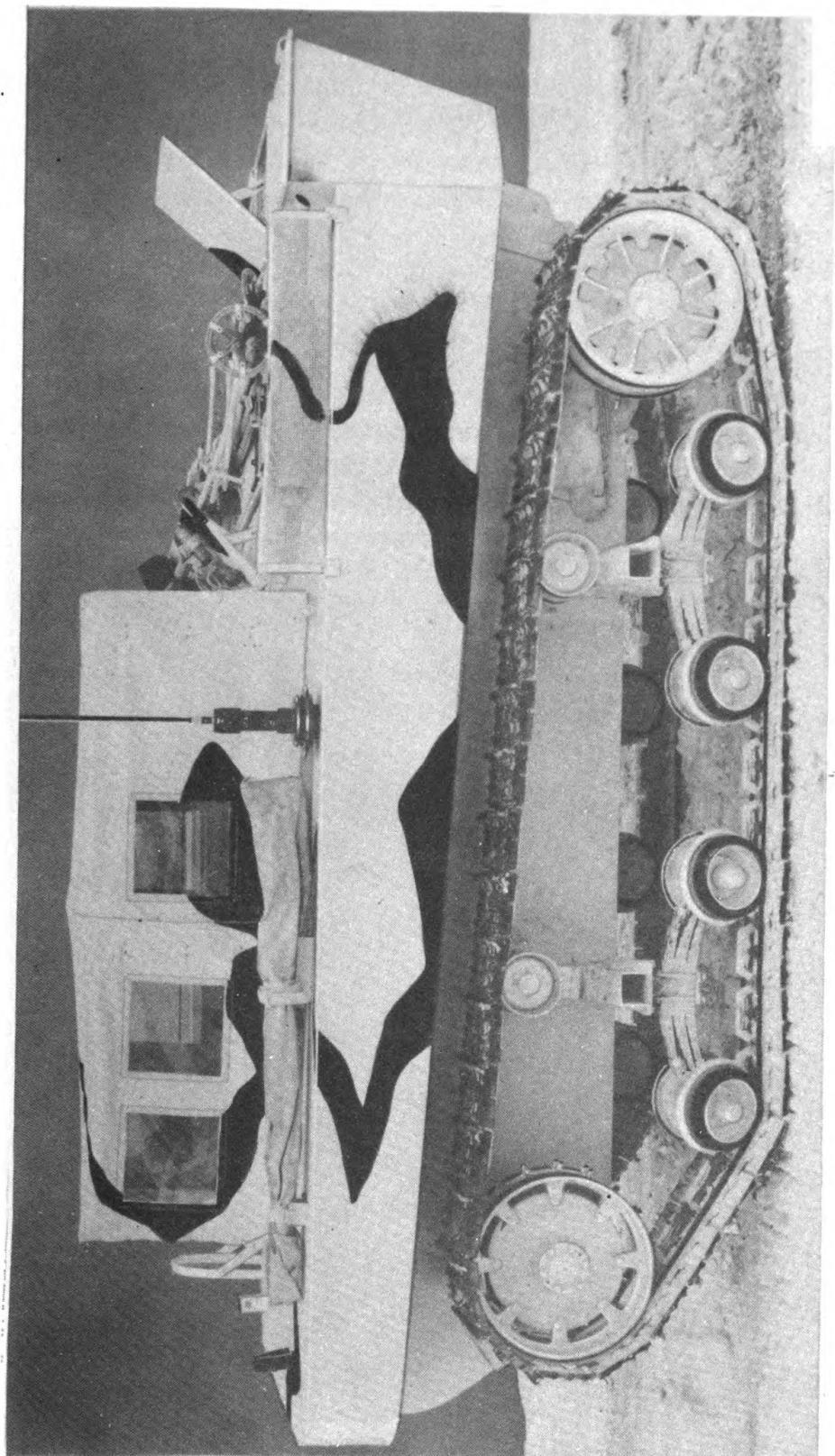
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Figure 2—Light Cargo Carrier T-15—Left Three-quarter Front

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Figure 3—Light Cargo Carrier T-15—Left Side

LIGHT CARGO CARRIER T-15

PART ONE—Operating Instructions

Section I

INTRODUCTION

	Paragraph
Scope	1
Characteristics	2
Differences among models	3
Data	4

1. SCOPE.

- a. This technical manual is intended to serve temporarily (pending the publication of a more complete revision) to give information and guidance to the personnel of the using arms charged with the operation, maintenance, and minor repairs of this materiel.

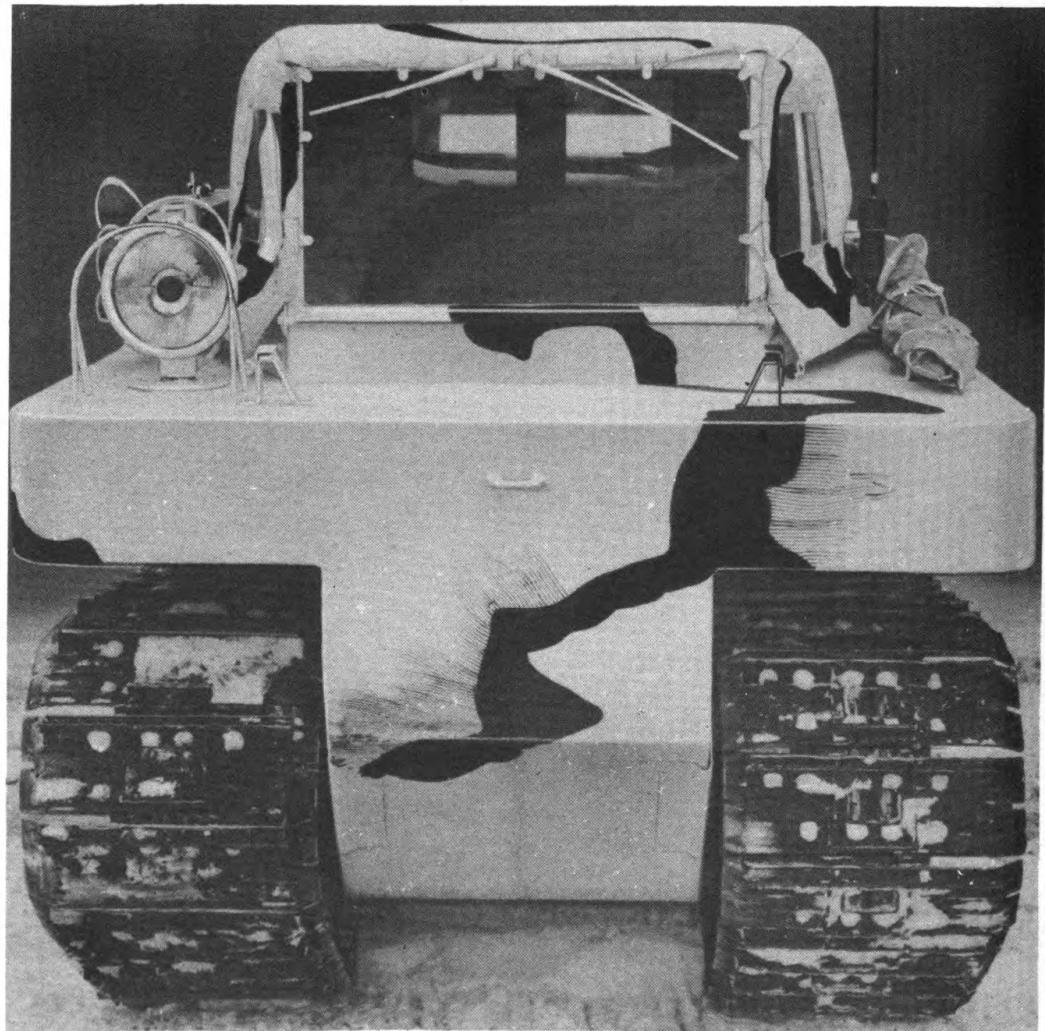


Figure 4—Light Cargo Carrier T-15—Front

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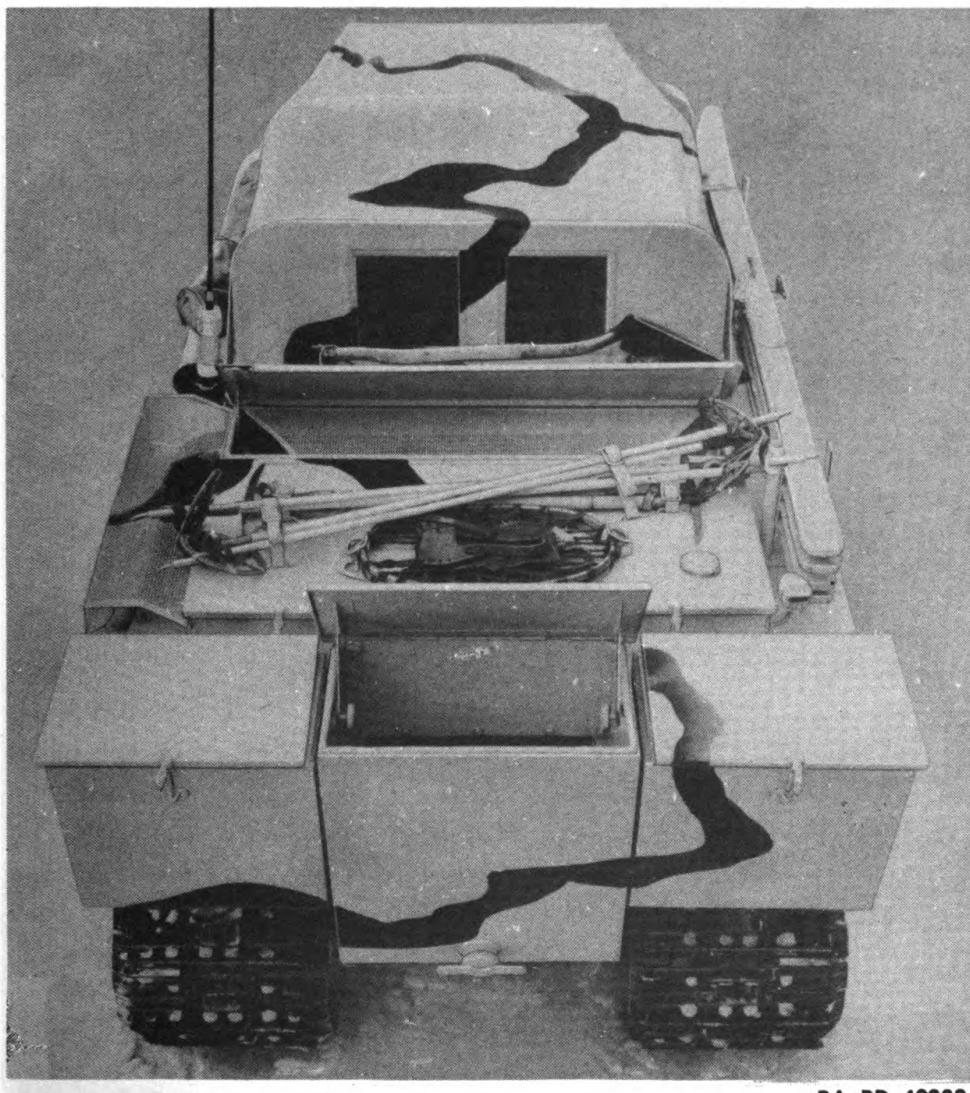
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INTRODUCTION

b. Disassembly, assembly, and such repairs as may be handled by using arms personnel may be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of facilities of the using arms, the responsible ordnance service must be informed so that trained personnel with suitable tools and equipment may be provided, or proper instructions issued.

d. This manual supersedes TM 9-893, dated September 15, 1942, which supplied only a limited amount of absolutely essential information for the operation and care of vehicle. The information contained herein is more complete.



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Figure 5—Light Cargo Carrier T-15—Rear

LIGHT CARGO CARRIER T-15

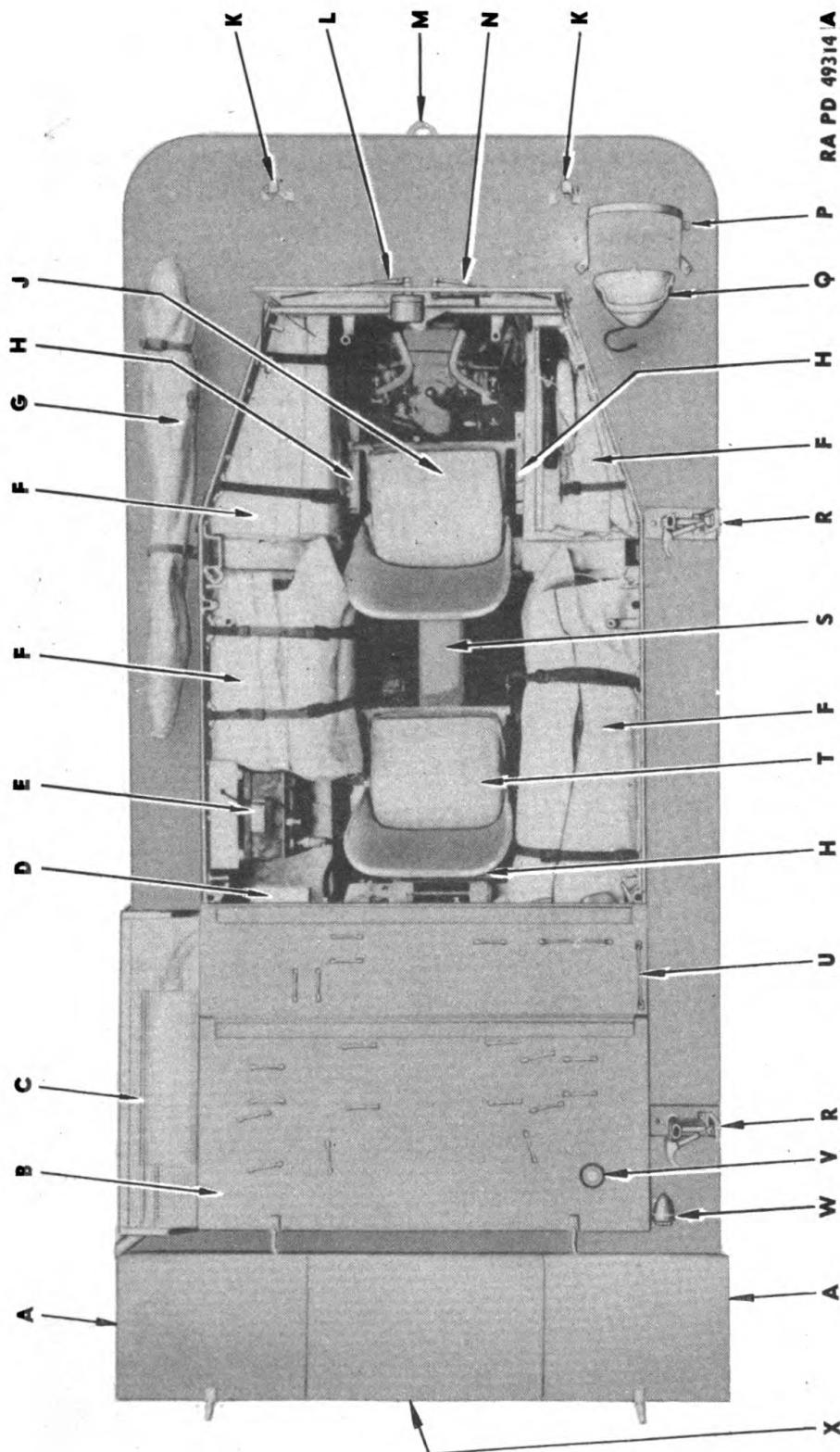


Figure 6—Light Cargo Carrier T-15—Top

INTRODUCTION

- A — REAR CARGO BOX
- B — ENGINE REAR COMPARTMENT LID
- C — EXHAUST MUFFLER GUARD
- D — DEMOLITION TIMER CONTROL BOX
- E — RADIO
- F — CARGO
- G — EXTERIOR MOUNTED ARMAMENT
- H — DEMOLITION CASE
- J — DRIVER'S SEAT
- K — WINDSHIELD BUMPER AND CLAMP
- L — ELECTRIC WINDSHIELD WIPER
- M — TOWING EYE
- N — MANUAL WINDSHIELD WIPER
- P — SPOT LAMP GUARD
- Q — SPOT LAMP
- R — SKI RACK
- S — PROPELLER SHAFT COVER
- T — ASSISTANT DRIVER'S SEAT
- U — ENGINE FRONT COMPARTMENT LID
- V — GASOLINE TANK FILLER CAP
- W — REAR MARKER LAMP
- X — REAR AIR DUCT

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Legend for Figure 6—Light Cargo Carrier T-15—Top

LIGHT CARGO CARRIER T-15

2. CHARACTERISTICS.

a. The Light Cargo Carrier T-15 is a low silhouette, full-track laying vehicle, carrying adequate armament and equipment for a crew of two men. It is designed for use over difficult terrain and in combat zones and will travel at a reasonably constant rate of speed. The vehicle is particularly constructed for cold weather operation where most of the traveling is over snow and ice. The vehicle is powered with a Studebaker Champion "L" head, liquid-cooled, 6-cylinder engine located at the rear of the hull (fig. 8). The flywheel end of the engine is connected by means of a single plate clutch, a conventional transmission, a propeller shaft, and 2 needle bearing type universal joints to the driving axle at the front of the vehicle. The axle is of the planetary 2-speed type and provides, together with the transmission, 6 forward gear ratios and 2 in reverse. The vehicle is fully suppressed for radio installation.

b. The hull consists of an 18-gage sheet steel welded structure, except for various covers which are easily removed to facilitate maintenance and inspection operations. Two plugs and one plate are provided on the bottom of the hull for draining purposes. The rear and side walls of the rear air duct and the front wall of the cargo boxes are of armor plate to protect the engine cooling system and rear of the hull.

3. DIFFERENCES AMONG MODELS.

a. There are no differences in the vehicles themselves. However, the armament and the type of radio with which the vehicles are equipped differ in accordance with ordnance requirements. For detailed information on this equipment, refer to the pertinent TM's as listed in section XXIII.

4. DATA.

a. General.

Weight of complete vehicle with oil, fuel and water	3,390 lb
Weight of crew and equipment	1,260 lb
Gross weight of vehicle	4,650 lb
Ground pressure per square inch:	
0-in. immersion	2.15 lb
6-in. immersion	1.68 lb
Over-all width	5 ft
Width of track	18 in.
Ground clearance	1 ft-0 in.
Tread (center to center of tracks)	3 ft-6 in.
Over-all height, with windshield perpendicular	5 ft-7 in.
Over-all length (with rear air duct and cargo boxes)	11 ft

INTRODUCTION

b. Engine.

Rated net horsepower at transmission pinion	70 at 3,800 rpm
Number of cylinders	6
Weight of complete engine with all accessories (less transmission)	418 lb
Firing order	1-5-3-6-2-4
Compression ratio	7 to 1

c. Interference points of the hull, adjacent to the driver's knees, are padded to protect the driver from injury when traversing exceedingly rough terrain.

d. Fuel and Oil.

Fuel capacity	25 gal
Octane rating of fuel	(80 at sea level (70 at 3,000 ft

At 30 mph on level hard snow or similar surface:

Gasoline consumption in miles per gal	4 $\frac{7}{10}$
Mileage obtainable without refueling	115
Engine oil capacity	5 qt
Oil consumption (approximate)	300 miles per qt
Lubricants	See section V

e. Performance.

Speed,

Sustained—level hard surface at 3,000 ft elevation	25 mph
Short periods—level hard surface at 3,000 ft elevation	35 mph
Cross country	Depends on terrain
Maximum allowable engine speed,	
Short periods	4,000 rpm
Sustained	3,300 rpm

PUBLICATIONS APPLYING TO THIS
VEHICLE
PARTS LIST SNL G- [REDACTED]
MAINTENANCE MANUAL T/M 9 [REDACTED]

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LIGHT CARGO CARRIER T-15

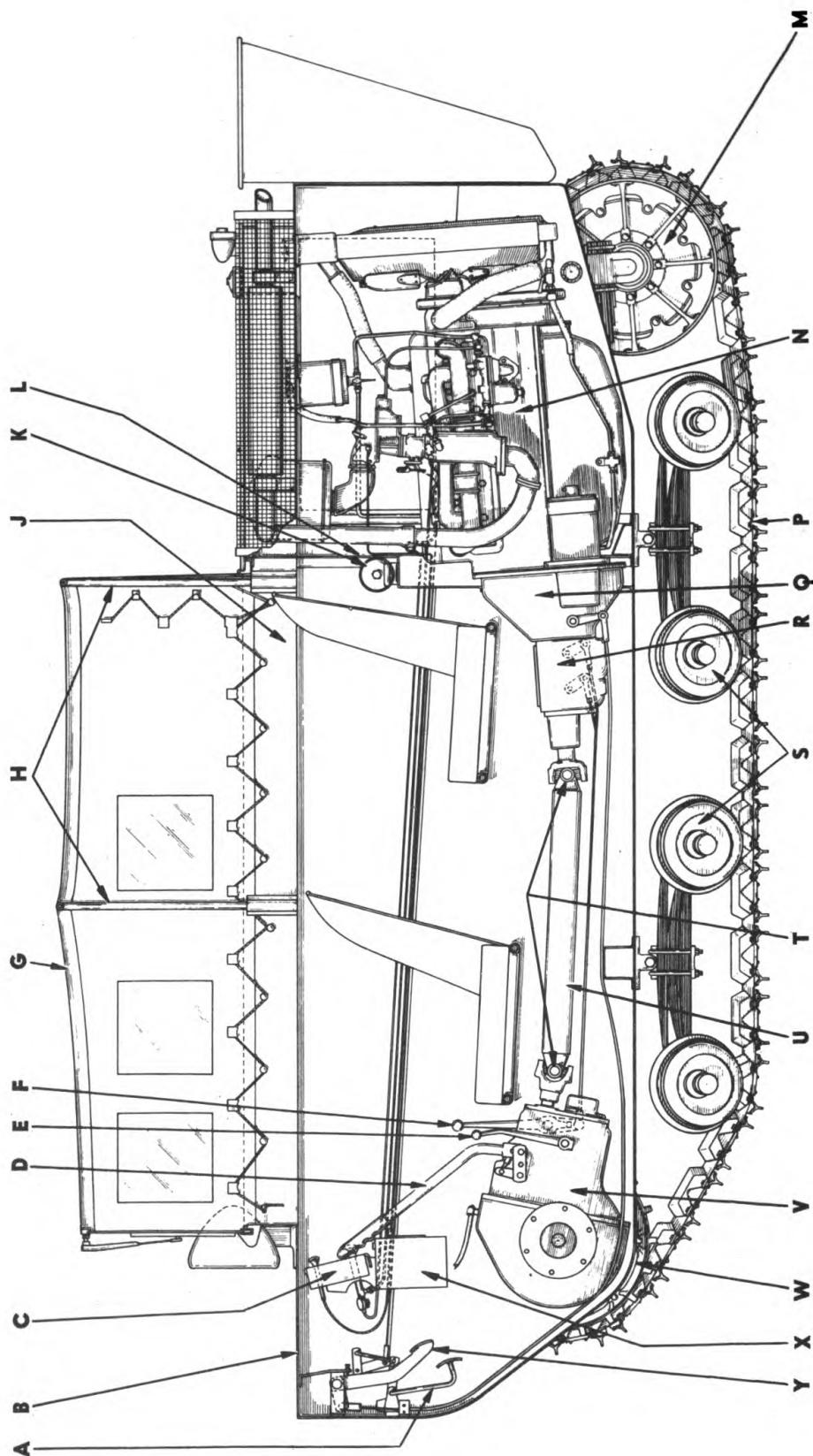


Figure 8—Light Cargo Carrier T-15—Longitudinal Section

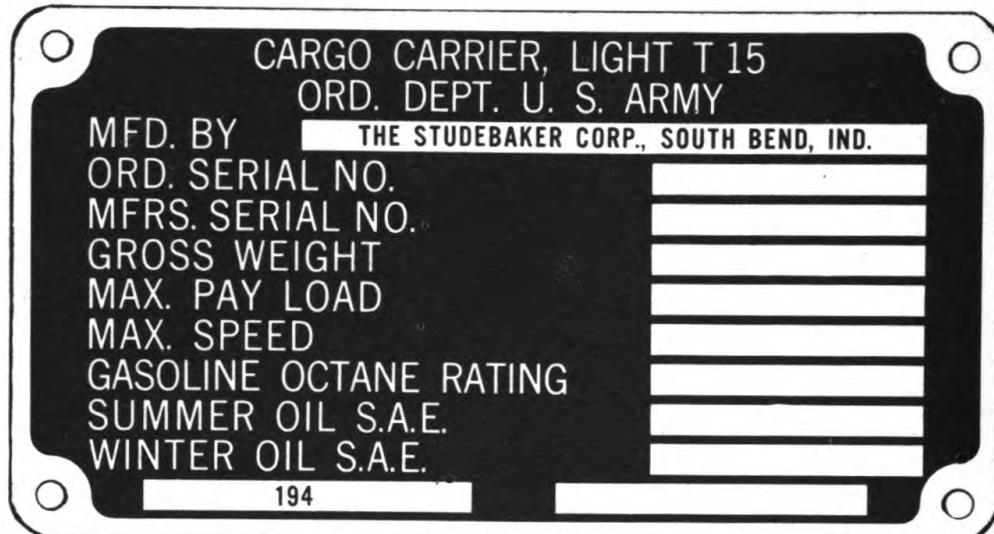
INTRODUCTION

- A** Accelerator pedal
- B** Vehicle deck
- C** Instrument panel
- D** Steering lever
- E** Axle shift lever
- F** Transmission remote control shift lever
- G** Top
- H** Top bow
- J** Deck coaming
- K** Fire extinguisher
- L** Bulkhead
- M** Rear wheel
- N** Engine
- P** Track
- Q** Clutch housing
- R** Transmission
- S** Bogie wheel
- T** Propeller shaft universal joints
- U** Propeller shaft
- V** Axle unit
- W** Drive wheel
- X** Compass
- Y** Clutch pedal

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Legend for Figure 8—Light Cargo Carrier T-15—Longitudinal Section

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Figure 9—Vehicle Identification Plate

Maximum grade ascending ability, Low gear, firm ground—3,000 ft elevation,	
100 percent tangent	45 deg
High gear, firm ground—3,000 ft elevation, 10 percent tangent	5 1/2 deg
Lateral capsizing angle	66 deg
Longitudinal capsizing angle	79 deg
Center of gravity from front of vehicle (vehicle—less crew and equipment)	5 ft-2 3/4 in.
Center of gravity below deck line (vehicle—less crew and equipment)	1 ft-10 in.
Maximum width of ditch that vehicle will cross	5 ft-1 in.
Maximum vertical obstacle, such as a wall, that vehicle will climb	1 ft 7 in.

Section II

OPERATION AND CONTROLS

	Paragraph
General information on controls	5
Prestarting inspection	6
Fuel required	7
Starting instructions	8
Engine test	9
Operating the vehicle	10
Stopping the engine	11
Towing instructions	12

5. GENERAL INFORMATION ON CONTROLS.

a. **Spark Control.** The spark control is automatic and is varied to suit engine operating conditions by a governor within the distributor.

b. **Carburetor Choke.** The choking of the carburetor for cold starts is accomplished by operating the carburetor choke control. The control button is mounted on the instrument panel and is readily accessible to the driver's right hand (fig. 10). Refer to Starting Instructions, paragraph 8, for additional information.

c. **Carburetor Throttle.** If desired (as during engine warm-up periods), the speed of the engine can be set by pulling out the carburetor throttle button on the instrument panel.

d. **Accelerator.** An accelerator pedal, accessible to the driver's right foot, provides a quick and positive control of engine speed.

e. **Steering Levers.** Steering levers, accessible to the driver's right and left hands, control the individual rotation of the drive wheels (fig. 10). The left steering lever, when moved rearward by the operator, will stop or retard the left drive track through the front axle planetary system and cause the vehicle to turn to the left. The right steering lever, when moved rearward, will cause the vehicle to turn to the right. The action is exactly the same when the vehicle is moving in reverse with respect to the direction in which the driver is facing; i. e., when the left steering lever is pulled rearward the vehicle will turn toward the muffler side, whereas, when the right steering lever is pulled rearward the vehicle will turn toward the gasoline tank side. The design of the axle is such that when one drive track is slowed down, the opposite track speed will increase; thus, the vehicle has power steering available whenever the drive system is in operation. The steering levers are mounted directly on the axle unit housing and are connected by links to the steering brake bands controlling the individual speeds of the drive wheels.

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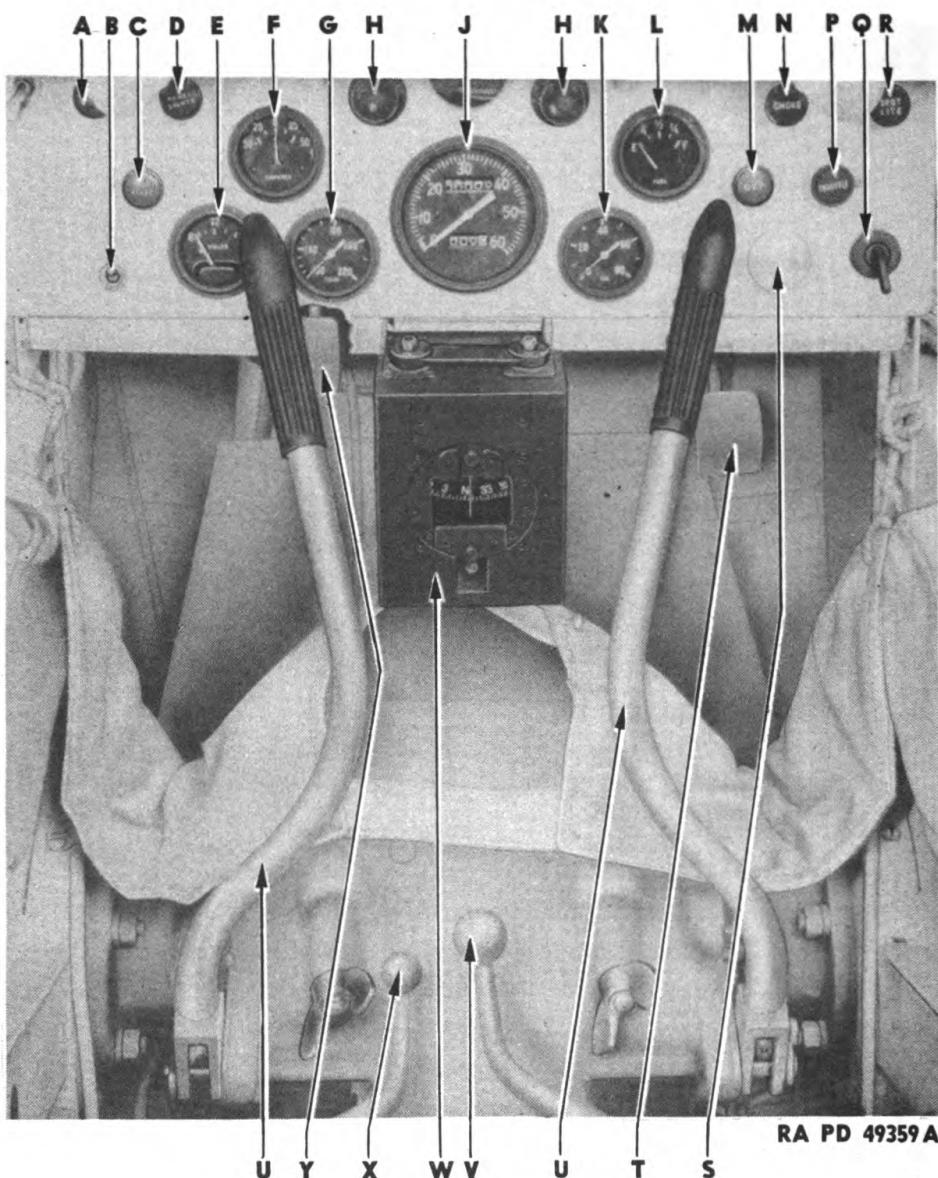


Figure 10—Instruments and Controls

f. Brakes. Pulling rearward simultaneously on both steering levers retards the speed of the vehicle. If enough effort is applied, such action will stop the vehicle. If the clutch is not released in stopping, the engine will stall.

g. Clutch. The engine clutch is located in the clutch housing immediately ahead of the engine (fig. 8). The clutch is controlled by a pedal.

OPERATION AND CONTROLS

- A** — WINDSHIELD WIPER SWITCH
- B** — VOLTMETER AND COMPASS LAMP SWITCH
- C** — STARTER PUSH BUTTON
- D** — INSTRUMENT PANEL LAMPS AND REAR MARKER LAMP SWITCH
- E** — VOLTMETER
- F** — AMMETER
- G** — ENGINE HEAT INDICATOR
- H** — INSTRUMENT PANEL LAMP
- J** — SPEEDOMETER
- K** — OIL PRESSURE GAGE
- L** — FUEL GAGE
- M** — WINDSHIELD DEFROSTER SWITCH
- N** — CARBURETOR CHOKE CONTROL
- P** — CARBURETOR THROTTLE CONTROL
- Q** — IGNITION SWITCH
- R** — SPOT LAMP SWITCH
- S** — PRIMER
- T** — ACCELERATOR PEDAL
- U** — STEERING LEVER
- V** — TRANSMISSION REMOTE CONTROL SHIFT LEVER
- W** — COMPASS
- X** — AXLE SHIFT LEVER
- Y** — CLUTCH PEDAL

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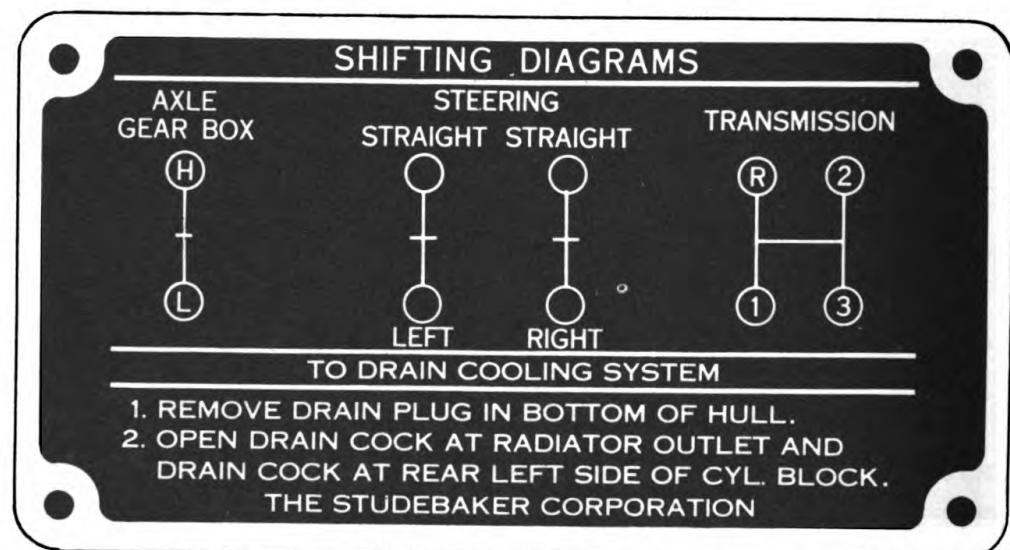
accessible to the driver's left foot. The pedal is connected by a cable and adjustable linkage to the clutch release shaft lever located at the clutch housing.

h. Gear Shifting.

(1) The transmission assembly unit located at the front of the clutch housing is connected by adjustable linkage to the transmission remote control shift lever (fig. 8). The lever is just ahead of the driver's seat. Moving the remote control lever from neutral (center) position to the left and rearward engages the low speed position; to the left and forward engages the reverse gear; from neutral to the right and forward engages the second speed position; while moving the lever to the right and rearward engages the high speed position (fig. 11).

(2) The axle unit has 2 speeds. The axle gear shift lever controlling axle speeds is located to the left of center and just ahead of the driver's seat. Moving this lever forward engages the axle high speed gear, while moving it rearward engages the axle low speed gear (fig. 11). Thus, with the 4 transmission speeds, there are available 6 gear ratios forward and 2 in reverse.

i. Lights. There are 2 exterior lights: a spotlight at the right front which is adjustable through a wide frontal range and a marker light at the right rear of the vehicle. Also, there are 2 instrument panel lights within the hull. The spotlight is controlled by a separate switch on the instrument panel. The rear marker light is included in the instrument panel light circuit so that the marker light burns when the 2 instrument panel lights are turned on.



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OPERATION AND CONTROLS

j. **Defroster Shield.** An electric heating element type windshield defroster is supplied and may be mounted by rubber suction cups to the windshield. The windshield defroster is operated by a switch on the instrument panel.

k. **Primer.** To aid in starting a cold engine, a pump-type engine primer is used to inject raw gasoline into the intake manifold. To operate the primer, slowly pull outward and then push in briskly on the primer handle located on the instrument panel.

l. **Diluter.**

(1) Another aid to starting in severe cold is a diluting device which semiautomatically dilutes the oil supply in the oil pan, thus lessening the possibility of difficult engine starting because of congealed oil. If the engine oil is allowed to become partially solidified, an extreme overload is placed on the battery which, in such weather, is not up to peak efficiency.

(2) The diluter is controlled by a 3-way valve connected to the fuel line and oil pan. When turned in one direction, the valve will permit gasoline to flow from the tank into a small gasoline reservoir above the engine. When the valve is turned in the opposite direction, gasoline flows into the engine oil pan from the reservoir. When the valve is at its mid-point position, the pipes to the oil pan and to the fuel tank are closed. The diluter must be manually operated just before stopping the engine so that a predetermined amount of gasoline (refer to the dilution chart—par. 56) is admitted first to the reservoir and then to the oil pan.

6. PRESTARTING INSPECTION.

a. The normal crew of this vehicle consists of two men and for the sake of expediency, both men must share the inspection work as directed by the driver. Inspections cover the complete vehicle.

(1) Check for fuel, oil, and water leakage into the interior of the hull and engine compartments. This check should include an inspection of the gasoline tank, battery heater connections, and the radiator. Check to see that all spark plug wires and coil wires are in place and that there is no broken insulation. Grasp the counter-balance of the manifold heat control valve to see that it is free and not seized in either the open or closed position.

(2) Check the level of the coolant in the radiator and test the strength of the solution if antifreeze is used. Add liquid or strengthen the anti-freeze solution as needed.

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(4) Note if there are any transmission oil leaks. Report leakage to ordnance personnel.

(5) Note if there are any oil leaks at the axle unit. Report leakage to ordnance personnel.

(6) Inspect the track guide wheels, bogie wheels, rear wheels, and the drive wheels. Determine by shaking whether any looseness exists. Inspect the bogie springs and the rear wheel tension springs. Note if there are any broken leaves and if the rebound clips are intact; also, if the U-bolts are tight.

(7) Check the condition of the drive track grouser plates and grousers, noting if any plates or grousers need to be replaced. Check the track tension with gage SD902836 supplied as part of the vehicle tool equipment and note if the track tension should be readjusted.

(8) Inspect the radio equipment to make sure it is operating and not damaged in any way.

(9) Remove the fire extinguisher from its mounting bracket, check the condition of the bracket, and determine if the extinguisher is filled with the proper fluid.

(10) Inspect and check the vehicle tools and pioneer equipment; note if all are on hand and if any require replacement.

(11) Check the steering levers for freeness on their pivots and at their pull links. Check the transmission remote control and axle gear shift levers for being free. If necessary, oil all of the lever linkage including that of the accelerator and clutch. See that the clutch has at least one inch of free movement at the clutch pedal before disengagement begins.

(12) Check the instrument panel. The ammeter hand should remain at zero with all switches in their "OFF" positions. The oil pressure gage hand should be at zero and the heat indicator and fuel gage hands should be in their starting positions.

(13) Turn on the voltmeter switch, note the reading and whether the compass internal lamp burns; then open the switch. Light all lamps and note the ammeter reading; then open the lamp switches. Check to make sure the spot lamp, marker lamp, and the instrument panel lamps operate.

(14) See that the fuel diluter valve is closed.

(15) See that the guns and ammunition are in good condition and are in their proper places.

(16) Inspect and check the rations, blankets, first aid kits, etc., and see that all are complete and stored correctly.

OPERATION AND CONTROLS

7. FUEL REQUIRED.

a. For best performance, gasoline with an octane rating of 80 should be used when operating at or near sea level. At 3,000 ft altitude 70 octane gasoline may be used satisfactorily.

8. STARTING INSTRUCTIONS.

a. With the engine front compartment lid open, press the starter push button to turn the engine several revolutions. The rear air duct lid must be closed. (This should have been done previously when the engine was stopped.) Use of the primer will depend on the prevailing temperature and whether or not the engine is already warm. For cold engine starting in subzero temperature, use the primer by pumping it one to five strokes depending on the temperature. For best results, pull the primer pump handle rearward slowly; then push it forward briskly. Bear in mind that improper use of the primer may easily add to the difficulty of starting if the engine is flooded.

b. Pull the carburetor choke control button outward to the full choke position.

c. Hold the accelerator pedal down about one-third of its normal travel.

d. See that the transmission remote control shift lever is in neutral.

e. Turn on the ignition switch.

f. Depress the clutch pedal to disengage the clutch from the engine flywheel and press the starter push button until the engine begins firing. Release the starter button the moment the engine starts to fire. If the engine does not fire promptly, investigate at once because continued cranking of the engine by the starter motor will only result in discharging the battery and flooding the cylinders with gasoline. Do not hold the starter push button in its closed position for more than 30 seconds at one time.

g. Do not race the engine to warm it. As soon as the engine starts to fire uniformly, gradually open the choke valve by pushing in on the carburetor choke control button. Do not open the choke valve too quickly. As the engine becomes warm, allow the throttle to close by releasing the accelerator pedal. Gradually engage the clutch by releasing the clutch pedal. Do not release the clutch quickly because congealed oil in the transmission will represent too great a load for the cold engine to carry. As the engine temperature rises, the closed rear air duct lid should be partially or fully opened as required for normal engine temperature.

h. A starting crank is provided with the equipment of the vehicle for manually cranking the engine. When it is known that the battery is low and the remaining energy in the battery will be needed to deliver

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a hot starting spark, manually crank the engine several times before turning on the ignition switch. This method is preferable to towing. Before using the starting crank, the crank guide cover must be removed by turning the cover in a counterclockwise direction one-quarter turn. After using the starting crank, be sure to reinstall the cover securely. The starting crank must be stored with the vehicle equipment after use.

9. ENGINE TEST.

a. As the engine starts, watch the oil pressure gage. The engine oil pressure should be the maximum, approximately 40 pounds, within not more than 10 seconds after the engine starts. If no oil pressure is indicated, stop the engine immediately and investigate.

b. Watch the ammeter. The hand of the ammeter should move immediately. In the case of a cold engine, the amount of charge should be very near the maximum rate of 33 to 35 amperes with the engine running at approximately $\frac{1}{3}$ throttle.

c. After the engine warms to operating temperature (less than 10 minutes should be required for this), the engine temperature indicator should show approximately 175 F. If the temperature rises appreciably higher, make sure the rear air duct lid is open. If the cover is open, investigate the cause of the overheating. The fan belt may be slipping or the coolant level may be dangerously low. CAUTION: If it has been necessary to operate the engine in an overheated condition and the coolant temperature has risen to the boiling point as indicated by the engine temperature indicator, do not at once remove the radiator cap to replace the coolant lost. Allow the steam to escape through the radiator overflow pipe by turning the sealing cap counterclockwise to its first stop. If this procedure is not followed severe burns may be inflicted on the hand from the escaping steam. Under the conditions outlined, do not attempt to fill the radiator unless the engine is running because a cracked cylinder block or cylinder head may result. If antifreeze solution is in use, the liquid added to the cooling system must be at least of the same strength as the coolant already in the system if the protection is to be preserved. In every case, the resultant solution must be tested after cooling solution has been added.

d. Listen for any unusual noises emanating from the engine or transmission. If any unusual noise is detected, either investigate and correct it or report the situation so that a thorough investigation may be made.

10. OPERATING THE VEHICLE.

a. Before attempting to operate the vehicle, the driver must become thoroughly familiar with the location and feel of all the controls.

b. Ordinarily the vehicle will be operated in the axle high gear range.

OPERATION AND CONTROLS

Shift the axle gear shift lever into the low gear range if difficult terrain is to be traversed.

c. Depress the clutch pedal to overcome the effort of the clutch pressure springs. If the desired direction is forward, move the transmission remote control lever into the first speed position (low). Gradually engage the clutch by allowing the left foot (depressing the clutch pedal) to be moved up and rearward by the clutch pressure springs and, at the same time, depress the accelerator pedal sufficiently to permit the engine to gain sufficient speed to move the weight of the vehicle.

d. As the vehicle gains momentum and the engine ceases to labor, depress the clutch pedal, allow the accelerator pedal to rise and, at the same time, shift the transmission gears to the second speed position (intermediate). Again, accelerate and engage the clutch slowly.

e. Repeat step d to shift to the third speed position (high).

f. If it is desired to move the vehicle rearward, follow the procedure given in step c, shifting the transmission gears into the reverse position. The vehicle must be stopped to change the transmission gears to the reverse position.

g. To steer the vehicle, pull back on the left steering lever to make a left turn or pull back on the right steering lever for a right turn. The sharpness of a turn is directly proportional to the extent to which a steering lever is pulled rearward. The driver must anticipate a turn and compensate for the extra power needed by simultaneously pulling back on the steering lever and depressing the accelerator pedal a slight additional amount.

h. To stop the vehicle, pull back slowly on both steering levers, depress the clutch pedal, and release the accelerator pedal—all in one smooth action. In some cases, as when encountering heavy terrain or while ascending a grade, it will not be necessary to apply much braking effort to the steering levers unless the grade is steep enough to require holding the vehicle from rolling backward. After the vehicle comes to a stop, move the transmission remote control shift lever to neutral and allow the clutch to engage.

i. Rely on the oil pressure gage, ammeter, and engine temperature indicator for indicating possible trouble. When any of the gages become erratic or show abnormal readings, investigate immediately the cause of the discrepancy.

11. STOPPING THE ENGINE.

a. Before stopping the engine for a halt of several hours during severely cold weather (-10°F or lower), operate the oil diluter to admit the proper amount of gasoline (refer to dilution chart—par. 56) into the engine oil pan. After diluting the oil with gasoline, operate the engine for 5 to 10 minutes at a fast idling speed to allow complete mixing.

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b. Turn off the ignition switch and, as the engine revolves to a dead stop, open the throttle by depressing the accelerator pedal to allow the cylinders to fill with a combustible mixture for the next start.

12. TOWING INSTRUCTIONS.

a. **Equipment.** Towing eyes are mounted at the front and rear of the vehicle. These eyes provide a quick method of attaching a vehicle or trailer to be towed.

b. **Precautions.** In towing there are several precautions that the driver must take to avoid trouble or unnecessary delay. Changes of direction should be accomplished by a series of short turns so that the vehicle being towed is, as nearly as possible, directly behind the one doing the towing. If this is not done and a continuous short turn is attempted, the towing cable or chain may become entangled in the track and result in damage to the track or cable. When entering muddy areas or when operating on snow or ice, if possible avoid turns of any kind and do not tow another track vehicle at a speed greater than 12 miles per hour.

c. **Method.** Fasten the cable, chain, or rope from the vehicle or trailer to be towed to the towing eye at the rear of the towing vehicle in such a manner that the pulling is in the plane of the towing eye. Before proceeding, make certain that the connecting cable does not contact the rear air duct or the left or right tracks. Estimate in advance the extent of turning possible without fouling the cable and tracks. At every halt or periodically, inspect the towing line and connections.

d. **Towing to Start Engine.** In an emergency where hand cranking fails, the engine can be started by towing. The operators of the two vehicles involved should proceed as follows:

(1) **TOWED VEHICLE:**

(a) Prime the manifold if necessary.

(b) Pull the carburetor choke control button out as in regular starting.

(c) Shift the axle to its high speed position.

(d) Shift the transmission to its high speed position.

(e) Turn on the ignition switch.

(f) Keep the clutch pedal depressed and signal to the operator of the towing vehicle to start.

(g) After the towing vehicle has gotten well under way (wait for signal), gradually engage the clutch and depress the accelerator pedal.

(h) When the engine begins firing, disengage the clutch, adjust the carburetor choke and throttle controls, and signal to the driver of the towing vehicle to stop.

(i) Shift the transmission to neutral and allow the engine to warm up at idling speed.

OPERATION AND CONTROLS

(2) TOWING VEHICLE (Engine Running):

NOTE: If possible, tow directly in front of the towed vehicle.

(a) Shift the axle to low and the transmission to low.

(b) Gradually release the clutch pedal and open the throttle at the same time, using a slightly greater amount of throttle opening to compensate for the additional load.

(c) Shift the transmission into second gear before signaling the other operator to engage the clutch of the towed vehicle. After the towing vehicle is well underway in second or high gear, depending on the terrain, signal for the driver to engage the clutch of the towed vehicle.

(d) When the driver of the towed vehicle has signaled that the engine is firing, stop and unhook the towing cable.

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Section III

ARMAMENT

	Paragraph
Guns	13
Ammunition	14

13. GUNS.

- a. For detailed description and information on the operation, care, and preservation of the armament with this vehicle, refer to technical manuals on guns listed in section XXIII. Vehicles differ in the type and quantity of armament carried; therefore, the following information includes all types used:
- b. **Browning Automatic Rifle, cal. .30.** This rifle is strapped to the vehicle left deck toward the front and beside the deck coaming.
- c. **Thompson Submachine Gun, cal. .45.** This gun is strapped to the interior of the hull in front of the cockpit, to the right of the driver.
- d. **Automatic Rifles or Carbines, cal. .30.** These rifles are strapped muzzle down within the cockpit, one on either side of the assistant driver.
- e. **Rocket Launcher.** The launcher is strapped to the vehicle left deck toward the front and beside the deck coaming. (Not used on vehicles equipped with Browning automatic rifle.)

14. AMMUNITION.

Gun	Caliber	Type of Cartridge	Number of Rounds	Number of Magazines	Stowed
Browning Automatic Rifle . . .	.30	ball	300	15	on hull
Thompson Submachine Gun . . .	.45	ball	375	15	in hull
Carbines . . . . .	.30	ball	300	20	in hull
TNT (20 boxes)					in hull

Section IV

PREVENTIVE MAINTENANCE

	Paragraph
Purpose	15
Prestarting inspection	16
Inspection during operation	17
Inspection at halt	18
Inspection after operation	19
Periodic inspections	20

15. PURPOSE.

a. In order to promote and insure uninterrupted operation it is highly important that this vehicle be inspected systematically according to the prearranged schedule.

b. For example, a crack may develop in a casting. This is sure to be discovered during one of the cyclic inspections by the appearance of an oily coating or other evidence. In this way, a costly interruption of service at some inopportune time will be forestalled.

c. Inform the Chief of Ordnance through the unit ordnance officer of any chronic troubles, mechanical failures, or any type of unsatisfactory operation which may be resulting from construction or design. Any suggestions for the improvement of the inspection procedures or handling technique, if based on actual experience, should likewise be communicated to the Chief of Ordnance so that all users of the equipment may benefit therefrom.

d. **Reports.** Suitable reports containing specific information must be prepared regularly and completely and should contain the following information:

(1) Identity of the vehicle and the correct name of the part or unit involved. This identity is to include the ordnance name of both the vehicle and the part, together with the U. S. registration number and the ordnance serial number.

(2) The manufacturer's name and number if any.

(3) The length of service in miles or time (hours, days, and months), or both if available.

(4) Date of replacement of the part or unit.

(5) Description of the failure and the conditions or circumstances under which the failure or damage occurred.

(6) The date of the failure and the name of the place where the failure occurred.

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- (7) The present location of the failing part or unit.
- (8) The source from which the new part or unit was obtained.
- (9) State whether the repairs were made by other than ordnance personnel and if so, from what source the labor was procured.

e. Make separate reports for each failure unless there are several identical failures on identical vehicles. In such a case a single report may be prepared, pointing out any difference existing in item number 5.

f. Hold all replaced parts or units reported on, for disposal instructions from the Chief of Ordnance.

16. PRESTARTING INSPECTION.

- a. Before starting the engine, perform the prestarting inspection operations outlined in paragraph 6.

17. INSPECTION DURING OPERATION.

a. While the vehicle is in operation, look for and be alert to detect any unusual sounds or odors indicating an unsatisfactory condition. Watch the instruments, especially the ammeter, oil pressure gage, and engine temperature indicator. Under normal conditions with a fully charged battery, the ammeter will show 8 to 10 amperes charge when the vehicle is traveling at cruising speed. If the ammeter continually shows discharge or a charge of 30 amperes or more, the electrical system must be checked and the difficulty corrected without delay. If an excessive charge is registering on the ammeter, it is very likely that a faulty condition exists within the voltage and current regulator. The regulator unit may require replacement to avoid damage to the battery. The oil pressure gage will show approximately 40 pounds pressure at cruising speed. If the gage suddenly drops to zero or starts surging, stop the engine and make an immediate investigation. There may be a broken oil line or the oil supply may be too low.

b. At cruising speed and under normal operating conditions, the engine temperature indicator should register approximately 175 F. If the indicator suddenly moves into the danger area, stop the engine and investigate. There may be a broken fan belt or hose connection and the coolant level may be low to a point where continued operation is impractical. Usually, when the instruments record any abnormality, there is something wrong and the cause should be determined and corrected at once. Keep alert for any unusual odor such as burning brake bands or electrical cables. Note any sudden loss of power or unusual labor of the engine. Such conditions may reveal trouble in the track, guide wheels, or in the axle.

c. If the vehicle is operated after trouble has been discovered, it will be uncertain as to how long complete failure can be averted unless an

PREVENTIVE MAINTENANCE

immediate halt is made for temporary repairs. If the driver is in doubt about some condition observed during operation, he must, when time permits, receive expert assistance and advice from an authorized source.

18. INSPECTION AT HALT.

a. At each halt any minor items noted during the period of operation must be corrected if time permits; also, a general going-over will be in order. Conditions which seem to be irregular during operation should be checked with the vehicle stopped.

b. The following routine inspection is recommended during the halt:

(1) Listen for unusual noises while the engine is idling. Note if there are any muffler or exhaust system leaks. Operate the manifold heat control valve by hand (with glove on hand to avoid burning) to determine if it is free.

(2) Look for any signs of fuel, oil, or water leaks under the engine, along the oil pan and valve covers, along the cylinder head, at the fuel pipes, radiator, and battery heater hose connections, at the oil pressure pipe and oil pump, and at the joint between the clutch housing and engine front plate.

(3) Make a careful inspection on both sides of the tracks to determine whether the grouser plates are all right and that the tension is satisfactory. Remove any large lumps of snow, ice, or stones which are likely to interfere with the operation of the vehicle track. Note if there are any plates or grousers broken and if the rubber guide belts are satisfactory.

(4) Examine the hull carefully for punctures or serious dents which are likely to fracture. Look for broken seams at welded joints.

(5) If it is permissible to operate the lights, test to see that they burn.

(6) Check the fuel supply and the coolant level in the radiator.

(7) Wipe the windshield with a clean rag and test the operation of both the electric and hand operated windshield wipers.

19. INSPECTION AFTER OPERATION.

a. At the end of each daily assignment make an inspection which is similar to, but more detailed than the one described for "At Halt". This inspection should include such repairs as can be made and any preventive maintenance indicated.

b. Check the track tension and adjust it if necessary (par. 103 a).

c. Inspect the track drive wheels, guide wheels, bogie wheels, rear wheels, track guide belts, grouser plates, and the support springs. Note if there are any worn, broken, or missing parts. Clean out any debris lodged in the suspension system.

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- d. Check the engine oil level, adding oil of the correct grade as required.
- e. Check the operation of the armament and see that they are stowed properly.
- f. Check the operation of all the lights.
- g. Check the ammunition and see that the required amount is in place. If not, procure the necessary ammunition and stow it properly.
- h. Check and fill the radiator. Check the radiator coolant strength if antifreeze is in use.
- i. Check the fan belt tension, adjusting it if necessary. Look particularly for any signs of fan belt deterioration.
- j. Inspect all electrical wiring and note if any wires need replacing.
- k. Make sure the diluter valve is closed, all lamps are off, and that the voltmeter and ignition switches are open.
- l. Test the operation of the primer.
- m. Clean the inside of the cockpit and wipe up all oil, water, and fuel within the engine compartment. The cockpit drain plug is located on the floor of the hull ahead of the assistant driver's seat, to the right of the propeller shaft shield. The drain plug is readily removable by using a 1 1/4-inch square socket, extension, and ratchet handle. When installing the drain plug the threads must be coated with LEAD, white, basic-carbonate, and the plug tightened securely.

20. PERIODIC INSPECTIONS.

a. After 500 Miles of Operation.

Points of Inspection	Preventive Maintenance Operations
Battery.	Remove the battery compartment cover, fill the battery with distilled water, and clean the terminals. Examine the battery case for leakage. Wipe off the top of the battery and inspect the battery heater coil and battery compartment insulation. Tighten battery ground strap and install battery compartment cover.
Cooling system.	Inspect all hose connections for leakage, inspect the radiator core for leaks, fill the radiator to the proper level, and test the strength of the solution if anti-freeze is in use.

PREVENTIVE MAINTENANCE

Fuel system.

Clean the fuel pump bowl and strainer. Clean the carburetor fuel strainer screen. Test the operation of the primer and diluter. Check for fuel leaks and eliminate any found. Check the fuel pump for proper operation and examine the fuel lines for leaks.

Ignition system.

Check all primary and secondary wires. Clean and tighten all terminals and repair or replace any wires having damaged or broken insulation. Remove and clean the distributor cap and rotor. Clean the ignition coil and tighten the mounting bolts. Examine the spark plug porcelains and replace any plugs having cracked or broken porcelain. Examine and tighten the condensers and suppressors. Clean the ignition breaker points and adjust the gap if necessary. Check the ignition timing and reset if required. Loosen the octane selector screw and move the distributor clockwise or counterclockwise to the point where the engine runs most smoothly for the particular fuel in use. Tighten the screw securely.

Carburetor.

See that the control linkage is free and adjust the carburetor idle mixture adjusting screw and throttle stop screw.

Air cleaner.

Clean and reoil the air cleaner filter element; wipe off the cover and body.

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Controls. Clean, adjust, and oil the accelerator, gear shift, choke, clutch, and steering linkage. Adjust the effective length of the control rods or cables when necessary.

Engine. Tighten the cylinder head cap screws and manifold stud nuts. Tighten the exhaust pipe flange and muffler to pipe clamps, and check for exhaust gas leaks. Note the condition of the engine oil. Wipe off the engine throughout.

Electrical system. Check the operation of the starter and generator. Remove the generator cover and check to see whether the brushes and commutator are clean and make good contact. Clean and tighten the terminals on all electrical cables. Remove the cap on the left front side of the clutch housing and clean the starter Bendix drive screw, pinion, and spring.

Axle unit. Tighten the unit cover screws and inspect for leaks. Remove the filler plug and check the lubricant level. Add oil as required. Tighten the U-bolt nuts at the front universal joint. Tighten the drive wheel carrier to axle unit bolts and the final drive axle shaft cap screws. Wipe off the axle unit.

Transmission. Tighten the transmission case cover screws. Remove the filler plug and check the lubricant level. Add oil as required. Inspect for oil leakage around the main shaft end. Wipe off the transmission unit.

PREVENTIVE MAINTENANCE**Clutch.**

Check the clutch pedal and readjust it as needed so that there is at least 1-inch free movement of the pedal before the clutch starts to disengage. Wipe off the clutch housing.

Top.

Examine the top for tears and repair as required.

Track and suspension system.

Report any damaged grouser plates and grousers. Tighten the bogie and rear wheel spring fastening U-bolt nuts.

b. After 1,000 Miles of Operation.

Perform the regular "Inspection after Operation" and 500-mile inspection. Adjust the steering brake bands and test the steering.

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Section V

LUBRICATION

	Paragraph
Introduction	21
Lubrication guide	22
Lubrication points	23
Reports and records	24

21. INTRODUCTION.

a. Lubrication is an essential part of preventive maintenance, determining to a great extent the serviceability of parts and assemblies.

22. LUBRICATION GUIDE.

a. General. Lubrication instructions for this materiel are consolidated in a lubrication guide (fig. 12). These specify the points to be lubricated, the periods of lubrication, and the lubricant to be used. In addition to the items on the guide, other small moving parts, such as hinges and latches, must be lubricated at frequent intervals.

b. Supplies. In the field it may not be possible to supply a complete assortment of lubricants called for by the lubrication guide to meet the recommendations. It will be necessary to make the best use of those available, subject to inspection by the officer concerned, in consultation with responsible ordnance personnel.

c. Lubrication Notes. The following notes apply to the lubrication guide (fig. 12). All note references in the guide itself are to the subparagraph below having the corresponding number:

(1) FITTINGS. Clean before applying lubricant. Lubricate until new lubricant is forced from the bearing, unless otherwise specified. CAUTION: Lubricate suspension points after washing carrier.

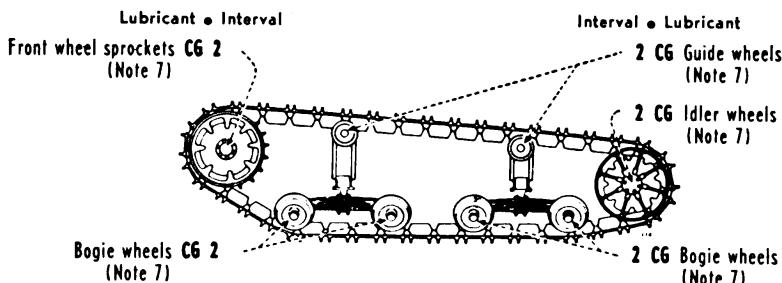
(2) Intervals indicated are for normal service. For extreme conditions of speed, heat, water, sand, mud, snow, dust, etc., reduce interval by $\frac{1}{3}$ or $\frac{1}{2}$, or more if conditions warrant.

(3) AIR CLEANER. Every 1,000 miles, remove and wash filter element. Reoil element with used crankcase oil or engine oil (crankcase grade), and replace. Every 1,000 to 3,000 miles, depending on operating conditions, remove air cleaner and wash all parts. CAUTION: Keep all air pipe connections clean and tight. Proper maintenance of air cleaners is essential to prolong engine life.

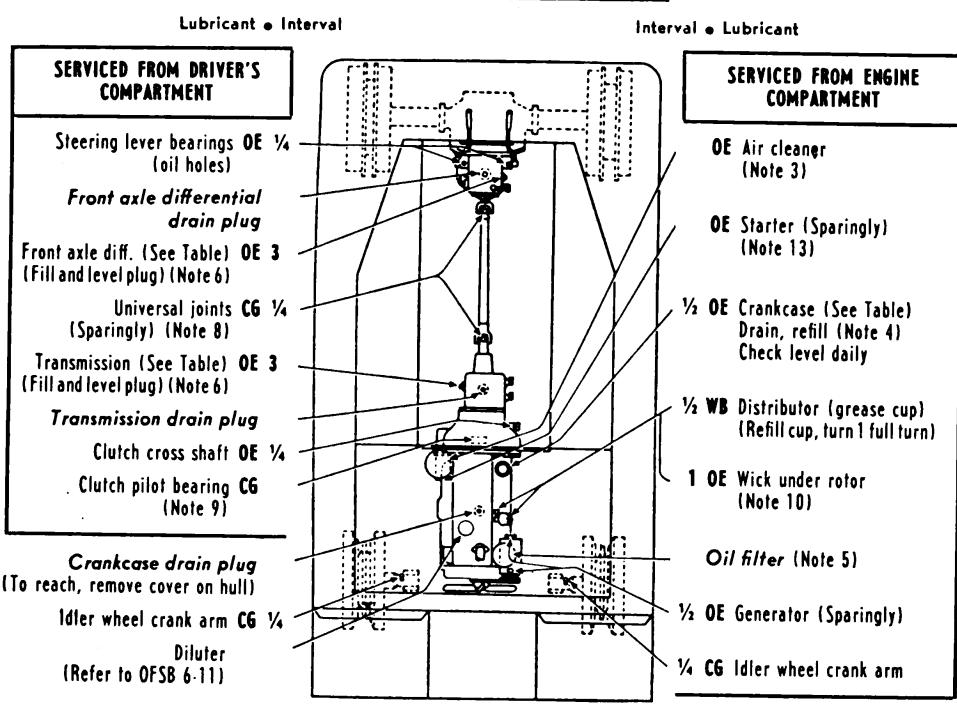
(4) CRANKCASE. Drain only when engine is hot. Refill to "FULL" mark on gage. Run engine a few minutes and recheck oil level. CAUTION: Be sure pressure gage indicates oil is circulating. See table.

LUBRICATION

MANUFACTURER'S SERIAL NUMBER located on left end of instrument panel.



CAUTION—Lubricate SUSPENSION SYSTEM points on BOTH SIDES of CARRIER



KEY

LUBRICANTS

OE—OIL, engine
Crankcase grade
(unless otherwise specified)

CG—GREASE, general purpose
No. 1 (above +32° F.)
No. 0 (+32° F. to 0° F.)

WB—GREASE, general purpose
No. 2

INTERVALS

$\frac{1}{4}$ —250 MILES
 $\frac{1}{2}$ —500 MILES
1—1,000 MILES
2—2,000 MILES
3—3,000 MILES

TABLE OF CAPACITIES AND LUBRICANTS TO BE USED

UNIT	CAPACITY	TEMPERATURE		
		+32° F AND ABOVE	+32° F TO 0° F	BELOW 0° F
CRANKCASE	5 QT.	OE	OE	REFER TO
TRANSMISSION	1/2 QT.	SAE 30	SAE 10	PAR. 35
FRONT AXLE UNIT	6 QT.			

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(5) **OIL FILTER.** Every 3,000 miles, or more often if necessary, renew filter element. After renewing element, refill crankcase to "FULL" mark on gage. Run engine a few minutes and recheck oil level.

(6) **GEAR CASES.** Weekly, check level with carrier on level ground; if necessary, add lubricant to correct level. Drain, flush and refill as indicated at points on guide. When draining, drain immediately after operation. To flush, fill cases to $\frac{1}{2}$ capacity with OIL, engine, SAE 10. Operate mechanism within cases slowly for several minutes and re-drain. Replace drain plugs and refill cases to correct level with lubricant specified on guide.

(7) **FRONT WHEEL SPROCKETS, BOGIE WHEELS, GUIDE WHEELS AND IDLER WHEELS.** When track is removed for repair, clean and repack bearings with GREASE, general purpose, seasonal grade. To properly adjust bearings, tighten adjusting nut until the wheel turns hard by hand; then back off $\frac{1}{16}$ turn. Lock nut in place.

(8) **UNIVERSAL JOINTS.** Remove seats and tunnel shield sections over universal joints and apply GREASE, general purpose, seasonal grade, until grease overflows from relief valve. Slip joint at front of shaft is lubricated from axle differential.

(9) **CLUTCH PILOT BEARING.** At time of clutch disassembly for inspection, replacement or overhaul, coat lightly with GREASE, general purpose, seasonal grade, to provide easy assembly.

(10) **DISTRIBUTOR.** Every 3,000 miles, wipe distributor breaker cam lightly with GREASE, general purpose, seasonal grade, and lubricate breaker arm pivot with OIL, engine, crankcase grade, sparingly.

(11) **OIL CAN POINTS.** Every 250 miles, lubricate transmission shift clevises and pins, engine cover hinges and latches, clutch clevises and pins, accelerator clevis pin with engine oil (crankcase grade).

(12) **POINTS REQUIRING NO LUBRICATION SERVICE.** Springs, water pump, slip joint, clutch release bearing, tracks.

(13) **POINTS TO BE LUBRICATED AT TIME OF ENGINE REMOVAL FOR PERIODIC INSPECTION.** Starter.

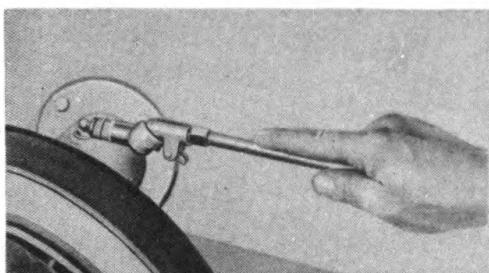
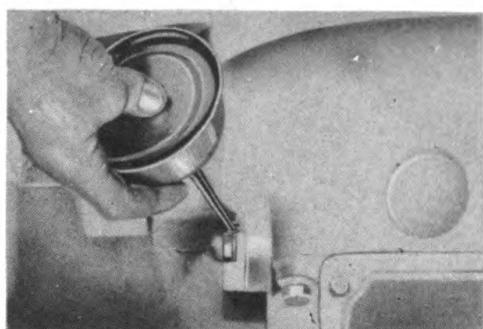
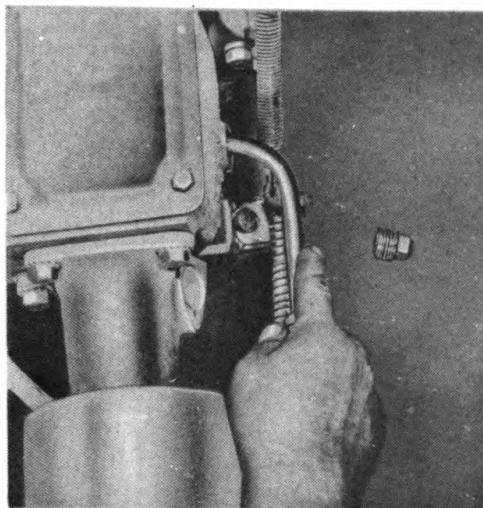
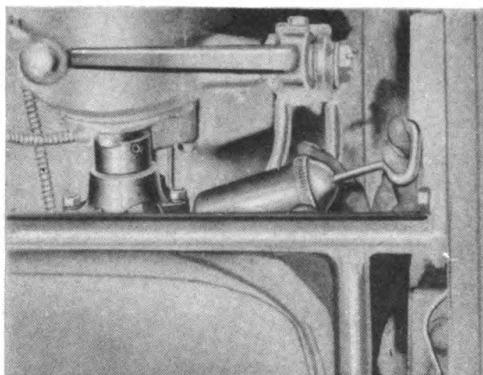
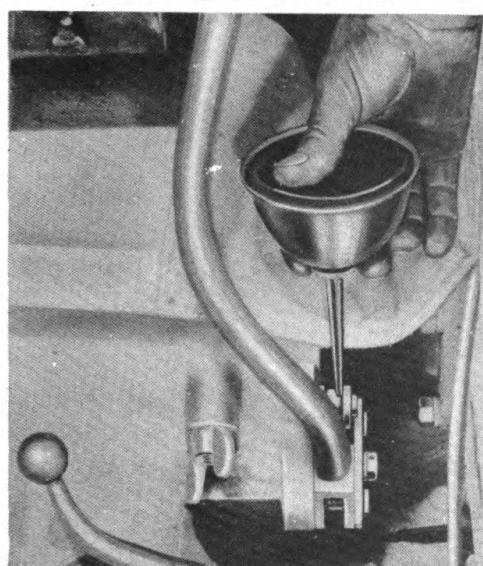
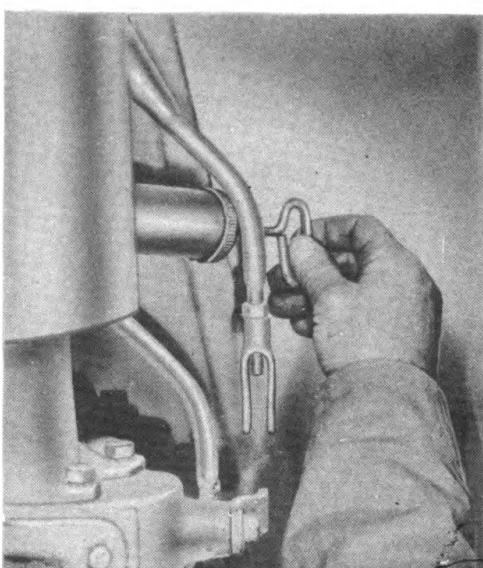
d. Additional Lubrication and Service Instructions on Individual Units and Parts.

(1) **COLD WEATHER.** For lubrication and service below 0 F, refer to OFSB 6-11.

23. LUBRICATION POINTS.

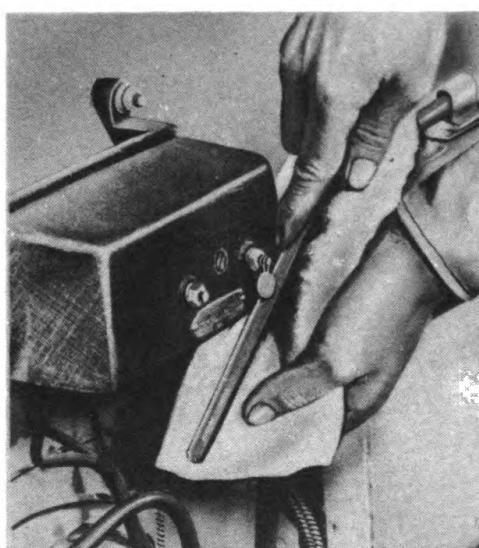
a. Figure 13 illustrates the lubrication of the front and rear universal joints, the rear wheel carrier, the transmission, the clutch release shaft, and the steering linkage. Figure 14 illustrates points of lubrication on the engine, the control linkage, the front axle unit, and the location of the engine oil drain plate in the hull.

LUBRICATION

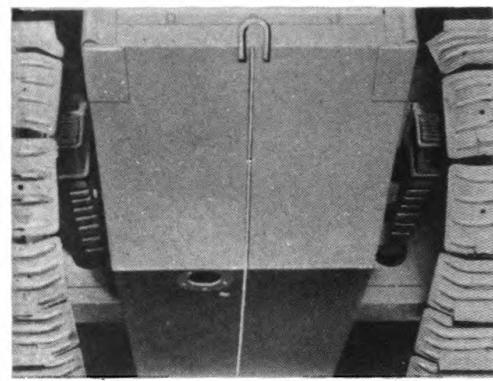
LUBRICATING REAR
WHEEL CARRIERLUBRICATING CLUTCH RELEASE
SHAFT BUSHINGFILLING TRANSMISSION WITH
LUBRICANT TO PROPER LEVELLUBRICATING FRONT
UNIVERSAL JOINTLUBRICATING STEERING
LEVER LINKAGELUBRICATING REAR
UNIVERSAL JOINT

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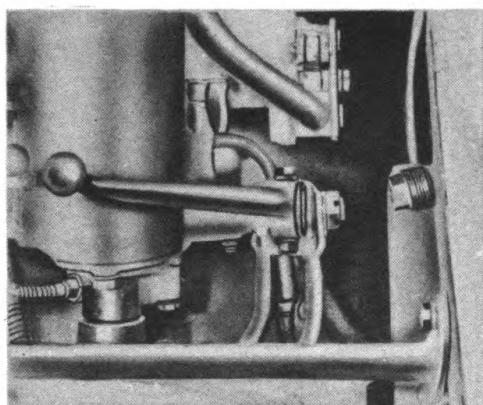
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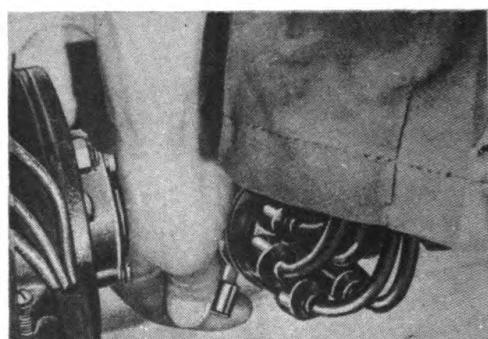
CHECKING ENGINE OIL LEVEL



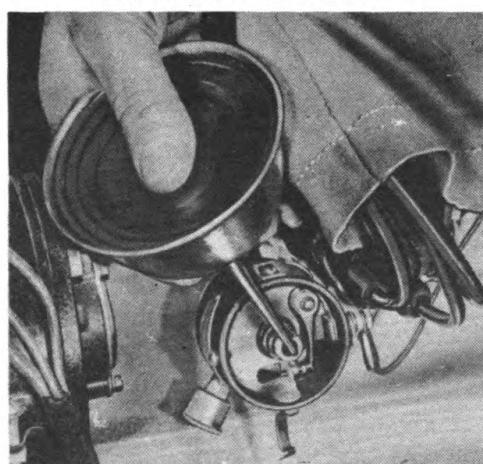
ENGINE OIL AND COOLING SYSTEM DRAIN POINTS



FILLING AXLE UNIT WITH LUBRICANT TO PROPER LEVEL



LUBRICATING DISTRIBUTOR SHAFT



LUBRICATING DISTRIBUTOR WICK



LUBRICATING TRANSMISSION CONTROL LINKAGE

RA PD 58310

LUBRICATION

24. REPORTS AND RECORDS.

- a. **Reports.** If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the ordnance officer responsible for the maintenance of the materiel.
- b. **Records.** A complete record of lubrication servicing will be kept in the motor book for the materiel.

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Section VI

CARE AND PRESERVATION

	Paragraph
Records	25
Cleaning	26
General information on painting	27
Preparing for painting	28
Painting metal surfaces	29
Paint as camouflage	30
Removing paint	31
Painting lubricating devices	32

25. RECORDS.

a. **Use.** An accurate record must be kept of each motor vehicle issued by the Ordnance Department. For this purpose the Ordnance Motor Book (O.O. Form No. 7255), generally called "Log Book," is issued with each vehicle and must accompany it at all times. This book furnishes a complete record of the vehicle and from it valuable information concerning operation and maintenance requirements are obtained. Organization commanders must insist that accurate entries be made. This record must be stored in a canvas cover to prevent it from becoming soiled or otherwise mutilated.

b. The page bearing a record of assignment must be destroyed prior to entering a combat zone. Also, any other postings regarding the identity of the organization must be removed.

26. CLEANING.

a. Grit, dirt, and mud are the sources of greatest wear to a vehicle. If deposits of dirt and grit are allowed to accumulate, particles will soon find their way into bearings to cause unnecessary wear and, if not remedied, serious difficulty.

b. When any of the vehicle's protected moving parts are exposed for maintenance repairs or replacement, be careful not to jar or brush sand and dirt into them. If by accident dirt does get into the parts, it must be thoroughly cleaned out before reassembling any parts.

c. To remove hardened, oil soaked dirt and grit, soak the area with SOLVENT, dry-cleaning, applied with rags or a brush. Continued soaking will loosen the deposits so that they can be scraped off. An additional soaking and brushing will serve to remove any of the deposit remaining. When water under pressure is available, it may be used to clean parts after the deposits have been soaked thoroughly with cleaning solvent.

CARE AND PRESERVATION

However, when water is used around the engine, care must be exercised to dry off all ignition and electrical apparatus.

d. Oilholes which have become clogged must be cleaned with a piece of wire, an awl, or a small drill point held in the hands. It is not advisable to use wood because the point may break off in the hole and add to the difficulty of opening it.

e. Take particular care to clean and decontaminate vehicles that have been subjected to a gas attack. See section IX on "Materiel Affected by Chemicals" for details of this operation.

27. GENERAL INFORMATION ON PAINTING.

a. Ordnance materiel is painted before issue to the using arms and one maintenance coat per year will ordinarily be ample for protection. This vehicle is painted both for protection and for camouflage with ENAMEL, synthetic, white, lusterless, one primer and two finish coats being applied at manufacture. New coats, when required, may be applied successfully over the original, provided the finish is not cracked or checked. It would be necessary to resurface any areas so affected.

b. Synthetic enamel for refinishing is usually issued ready for use and is applied either by brushing or spraying. If the finish is to be applied by brushing, thin no more than 5 percent by volume with THINNER, for synthetic enamels. If the enamel is to be sprayed, thinning to 15 percent by volume will give the right consistency. Use only the reducers furnished for this enamel. If the finish is sprayed, it will dry hard enough for repainting within $\frac{1}{2}$ hour and hard in 16 hours.

c. The vehicle's armament and instruments are not to be painted.

28. PREPARING FOR PAINTING.

a. If the base coat on the materiel is in poor condition, it is more desirable to strip the old paint from the surface than to use sanding and touch-up methods. After stripping, it will then be necessary to apply a primer coat.

b. PRIMER, ground, synthetic, should be used on wood as a base coat for synthetic enamel. It may be applied either by brushing or spraying. It will brush satisfactorily as received or after the addition of not more than 5 percent by volume of THINNER. It will be dry enough to touch in 30 minutes, and hard in 5 to 7 hours. For spraying, it may be thinned with not more than 15 percent by volume of THINNER.

c. PRIMER, synthetic, rust inhibiting, for bare metal, should be used on metal as a base coat. Its use and application is similar to that outlined previously in paragraph b.

d. The success of a job of painting depends partly on the selection of a suitable paint, but also largely upon the care used in preparing the surface

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prior to painting. All parts to be painted should be free from rust, grease, kerosene, oil, alkali, and must be dry.

29. PAINTING METAL SURFACES.

a. If metal parts are in need of cleaning they should be washed in a liquid solution consisting of $\frac{1}{2}$ -pound of **SODA ASH** in 8 quarts of warm water, or an equivalent solution; then rinsed in clear water and wiped thoroughly dry. Wood parts in need of cleaning should be treated in the same manner, but the alkaline solution must not be left on for more than a few minutes and the surfaces should be wiped dry as soon as they are washed clean. When the finish is in fair condition and only marred in spots, the bad places should be touched up with **ENAMEL**, synthetic, white, lusterless, and permitted to dry. The touched up areas should be thoroughly sanded with **PAPER**, flint, No. 1. After all dust and sand has been removed, finish coat with **ENAMEL**, synthetic, white, lusterless, and allow for thorough drying before using the equipment. If the surface is generally bad from service and wear and there is no indication of finish failure such as checking and cracking, sand the entire surface with **PAPER**, flint, No. 3, apply **PRIMER**, ground, synthetic, and allow to dry for at least 16 hours. Sand the primed surface with **PAPER**, flint, No. 00, wipe off all dust, and apply a finish coat of **ENAMEL**, synthetic, white, lusterless. Allow the finish to dry thoroughly before the materiel is used.

30. PAINT AS CAMOUFLAGE.

a. Camouflage is now a major consideration in painting ordnance vehicles, with rust prevention secondary. The camouflage plan employed at present utilizes three factors: color, gloss, and stenciling.

b. **Color.** The paint finish on this vehicle definitely serves as camouflage as well as protection for the metal hull and exposed working parts. Because the vehicle operates over snow and ice, it is important that the white finish be kept intact at all times. When repairs are made which destroy the paint, the repaired areas should be repainted whenever time permits.

c. **Gloss.** **ENAMEL**, synthetic, white, lusterless, used in the finish of this vehicle together with irregular camouflaging marks of **PAINT**, gasoline soluble, black, lusterless, make it difficult to see the vehicle from the air or from relatively great distances over land. For these reasons, a glossy finish should never be substituted for the lusterless finish when repainting.

d. **Stenciling.** The identification numbers of this vehicle are in blue drab stencil enamel which can not be photographed from the air, and are illegible to the eye at distances exceeding 75 feet.

CARE AND PRESERVATION**e. Preserving Camouflage.**

(1) Because continued friction or rubbing action on this vehicle's lusterless finish will result in the rubbed areas becoming glossy, steps should be taken to prevent such friction. Do not wash the vehicle more than once a week. When washing, do what rubbing is necessary with a sponge or a soft cloth and do not rub any surfaces except when wet.

(2) It is not desirable to keep lusterless finished vehicles as clean as those finished in gloss. However, grease spots or any soil which shows up plainly on white should be kept to a minimum through the use of **SOLVENT**, dry-cleaning.

(3) Continued friction of wax-treated tarpaulins will produce a gloss which should be removed with **SOLVENT**, dry-cleaning.

(4) One complete finish coat each year is recommended, but this may be unnecessary as indicated by a careful inspection. The identification numbers will need refinishing twice a year.

31. REMOVING PAINT.

a. After repeated paintings, the paint may become so thick as to crack and scale off in places, presenting an unsightly appearance. If such is the case, remove the old paint with paint remover or a lime-and-lye solution (see TM 9-850 for details). It is important that every trace of the solution or the paint remover be completely rinsed off and that the equipment be perfectly dry before painting is attempted. The surface thus prepared should be painted according to directions in paragraphs 27 and 28.

32. PAINTING LUBRICATING DEVICES.

a. (*Lubrication points on new vehicles are not painted as described in this paragraph.*) Oil cups, grease fittings, oil plugs, and oilholes as well as a surrounding circular area of $\frac{3}{4}$ inch should be painted with **ENAMEL**, red, water resisting, in order to facilitate lubrication by definitely identifying all lubrication points.

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Section VII

TOOLS AND EQUIPMENT ON VEHICLE

	Paragraph
Tools	33
Equipment	34

33. TOOLS (fig. 15).

BRACKET, rear wheel tension spring release, SD902748
CAN, oil, SD666909
CRANK, starting, SD636180
GAGE, track spring tension, SD902836
HAMMER, ball peen, SD664715
HANDLE, jack, SD903401
HANDLE, spark plug wrench, SD664327
JACK, vehicle, SD903400
PLIERS, combination, SD664713
RERAILER, track, SD903412
SCREWDRIVER, 3 $\frac{1}{2}$ -in., SD196761
SCREWDRIVER, 6-in., SD664321
WRENCH, auto, adjustable, 15-in., SD664666
WRENCH, adjustable, open-end, 12-in., crescent type, SD664665
WRENCH, double, open-end, $\frac{3}{8}$ -in.- $\frac{7}{16}$ -in., SD664330
WRENCH, double, open-end, $\frac{1}{2}$ -in.- $1\frac{9}{32}$ -in., SD634331
WRENCH, double, open-end, $\frac{9}{16}$ -in.- $1\frac{1}{16}$ -in., SD634332
WRENCH, double, open-end, $\frac{5}{8}$ -in.- $2\frac{5}{32}$ -in., SD634333
WRENCH, double, open-end, $\frac{3}{4}$ -in.- $\frac{7}{8}$ -in., SD634334
WRENCH, socket, spark plug, $1\frac{3}{16}$ -in., SD512819

34. EQUIPMENT.

	Equipment	Stowage Position
Box		Within hull, right side
	(Containing:	
	Flashlight (2)	
	Sewing kits (2)	
	Cups (2)	
	Knives (2)	
	Forks (2)	
	Leather mittens (6 pr.)	
	Wristlets (2 pr.)	
	Ski climbing skins (2 pr.)	
	Windproof mittens (2 pr.)	

TOOLS AND EQUIPMENT ON VEHICLE

Equipment	Stowage Position
Trigger finger liners (2 pr.)	
Toques (2)	
Goggles (2 pr.)	
Heavy wool socks (4 pr.)	
Wool ski socks (4 pr.)	
Alaskas (2 pr.)	
Bedrolls (2)	Within hull, right side
Air mattress rolled (Containing:	Within hull, right side
White pants (1 pr.)	
Sleeveless wool sweaters (2)	
Wool muffler	
Wool underwear shirt	
Wool drawers	
Alaskas (1 pr.)	
Wool turtleneck sweater	
Ski pants (1 pr.)	
Olive-drab wool (shirt)	
Stove	Within hull, right side
Mountain climbing rope (1 roll)	Within hull, right side
Tent	Within hull, right side
Ski repair kit	Within hull, right side
Stand for hand generator	Within hull, right side
Ski wax (1 box)	Within hull, right side
Cable for hand generator	Within hull, right side
Pail	Within hull, right side
Alpaca lined parkas (2)	Within hull, left side
Reversible parka	Within hull, left side
Candles (1 box)	Within hull, left side
Thermos bottle	Within hull, left side
Air mattress rolled and containing same equipment as listed under other mattress item	Within hull, left side
Radio	Within hull, left side
Hand generator for radio	Within hull, under rear seat
Box radio spare parts	Within hull, under rear seat
Food boxes (15)	Within hull, beside driver
Oil cans, 1 qt (3)	Within hull, beside driver
Skis (2 pr.)	On right deck
Mountain ice axes (2)	On engine compartment lid
Ski poles (2)	On engine compartment lid

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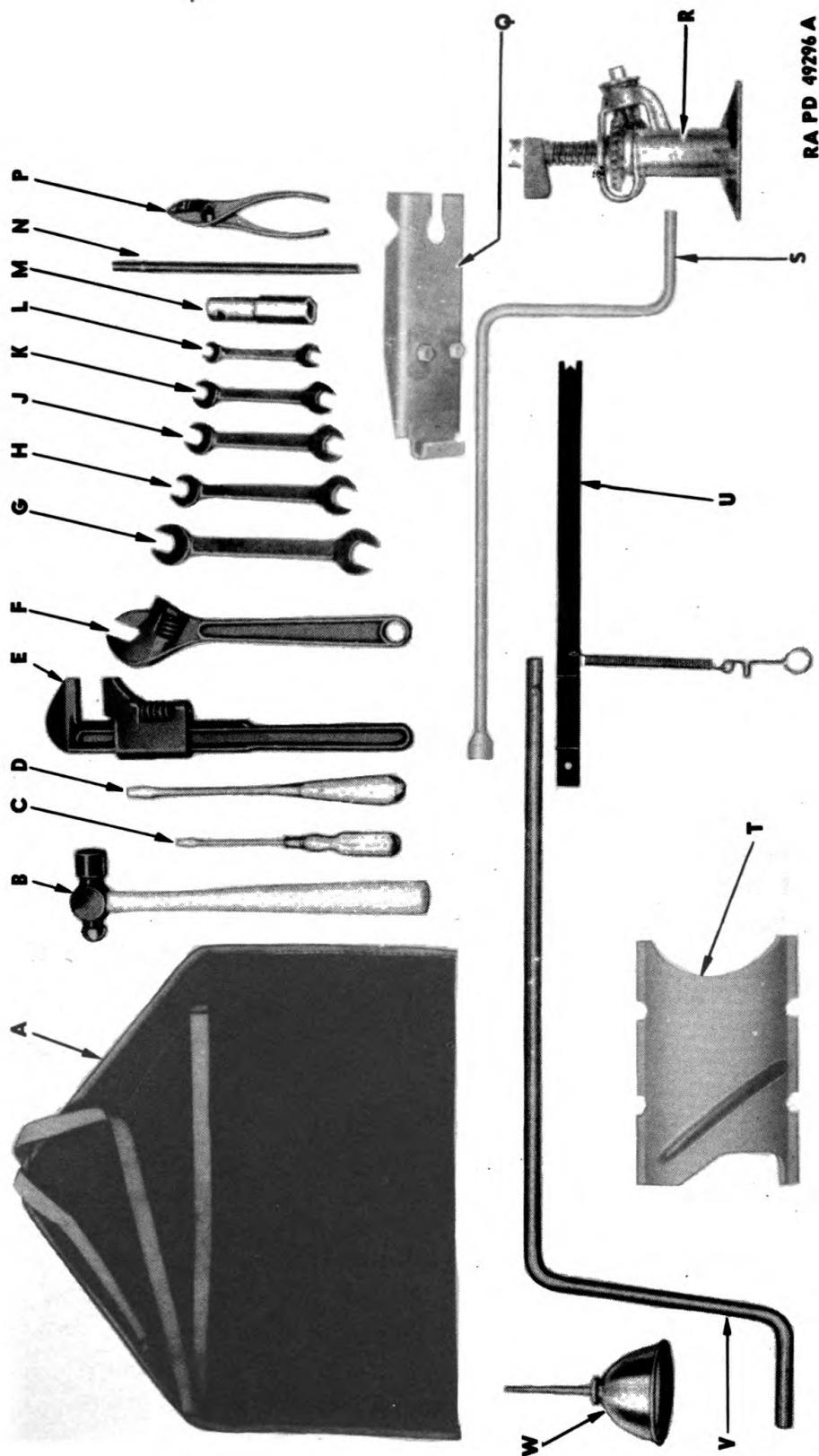


Figure 15—Vehicle Tools

TOOLS AND EQUIPMENT ON VEHICLE

- A — TOOL BAG
- B — BALL PEEN HAMMER
- C — SCREWDRIVER (3-1/2-IN.)
- D — SCREWDRIVER (6-IN.)
- E — AUTO ADJUSTABLE WRENCH (15-IN.)
- F — ADJUSTABLE OPEN-END WRENCH (12-IN.)
- G — DOUBLE OPEN-END WRENCH (3/4-IN. - 7/8-IN.)
- H — DOUBLE OPEN-END WRENCH (5/8-IN. - 25/32-IN.)
- J — DOUBLE OPEN-END WRENCH (9/16-IN. - 11/16-IN.)
- K — DOUBLE OPEN-END WRENCH (1/2-IN. - 19/32-IN.)
- L — DOUBLE OPEN-END WRENCH (3/8-IN. - 7/16-IN.)
- M — SPARK PLUG SOCKET WRENCH
- N — SPARK PLUG WRENCH HANDLE
- P — COMBINATION PLIERS
- Q — REAR WHEEL TENSION SPRING RELEASE BRACKET
- R — JACK
- S — JACK HANDLE
- T — TRACK RE-RAILER
- U — TRACK SPRING TENSION GAGE
- V — STARTING CRANK
- W — OIL CAN

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Legend for Figure 15—Vehicle Tools

LIGHT CARGO CARRIER T-15

Equipment	Stowage Position
Axe	On engine compartment lid
Shovel	On engine compartment lid
Snow shoes (4)	On engine compartment lid
Rucksacks (2)	One in each rear compartment

Section VIII**OPERATION UNDER UNUSUAL CONDITIONS**

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Lubrication of linkage	38
Chassis lubricants	39
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Electrical system	41
Starting and operation	42
Cold weather accessories	43

35. GENERAL.

a. The operation and maintenance of this vehicle at low temperatures involves factors which do not exist at normal temperatures. Therefore, the driver and the maintenance personnel must spend more time than might be expected in protective maintenance. Failure to give the extra servicing attention required will result in damage, loss of time, and engine starting difficulties.

b. Low temperatures have been divided into two ranges: -10 F to -40 F, and below -40 F. Lubricants undergo changes in their physical properties below -40 F; and since there may be instances when the vehicle is operated in such temperatures, auxiliary heat to the engine, fuel, oil, and intake air will be required.

36. FUEL.

a. The fuel lines of this vehicle are within the engine compartment; nevertheless, formation of ice crystals from small quantities of water in the fuel may produce operating difficulties if the temperature is low enough. The following precautions should be adhered to in an effort to reduce moisture accumulation in the fuel tank of the vehicle:

(1) Strain the gasoline when pouring or pumping it into the fuel tank. **CAUTION:** Always touch the nozzle of the filler hose or can to the hull before the gasoline starts to flow. This will discharge any developed static electricity.

(2) When possible, keep the fuel tank full. This will reduce condensation of moisture from the free air space above the fuel.

(3) Do not store gasoline in drums which have not been cleaned thoroughly.

(4) Do not pump fuel drums dry; instead, allow about 4 inches of fuel to remain in the drum. This residue can be transferred later to a

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settling tank. When time permits, allow a full drum of fuel to settle for a day after it has been moved. Keep portable fuel pumps clean and protect them from snow and frost. Protect the vehicle fuel tank against entry of snow and foreign matter while filling.

(5) When a fuel drum has been opened, be sure that the plug is replaced to prevent the entry of any foreign matter. When possible store full fuel drums under cover.

(6) See that the fuel line connections on the vehicle are tight and in good condition at all times.

37. ENGINE LUBRICATION.

a. Engine lubrication is covered in section V. However, the following extreme cold weather precautions will supplement the lubrication instructions and are applicable only when temperatures remain constantly below -10 F for long periods:

(1) When a building is available, store the vehicle inside. Where no building is available, endeavor to park the vehicle where it will be protected from the wind by natural means.

(2) If the vehicle must be stored outside and if there are no natural wind breaks, cover the engine carefully.

(3) Dilute the engine oil as required (par. 56). The following table shows the amount of gasoline which should be added to the engine oil by means of the diluter:

Temperature	Percentage of Dilution	Amount of Diluent
0 F	None	None
-10 F	None	None
-20 F	10 percent	1/2 qt
-30 F	20 percent	1 qt
-40 F	30 percent	1 1/2 qt

(4) In the event the diluter was not operated prior to the last time the engine was stopped, it will probably be necessary to direct heat from an outside source to the engine compartment in order to thin the oil.

(5) While the engine is operating with diluted oil, the oil consumption rate may increase considerably. Special attention should be given to observing the engine oil pressure gage and the oil level in the pan as indicated on the dip stick. Also, check the oil frequently for sludge and evidence of condensation. Change the engine oil as often as required to avoid this condition.

(6) Use diluted oil at all points lubricated with an oil can.

(7) Under tactical conditions where it is absolutely essential for the engine to start quickly, it may be considered advisable to institute hourly or half-hourly checks by one or several experienced operators

OPERATION UNDER UNUSUAL CONDITIONS

who have been delegated to start all the engines of the vehicles comprising the command. The engine should be run for a 5- to 10-minute period to prevent it from becoming completely cold and to assure quick starting on short notice. The frequency of the check and the time the engine is operated should be varied to suit the conditions encountered. While the engine is idling for a periodic warm-up, set the hand throttle control at a point where the ammeter registers charge.

38. LUBRICATION OF LINKAGE.

a. Use diluted oil in an oil can to lubricate the linkage of the steering levers, clutch, throttle, and transmission.

39. CHASSIS LUBRICANTS.

a. Lubricate with diluted oil any points about the vehicle normally requiring grease because in extremely low temperatures it is impossible to apply grease. As soon as possible after using diluted oil on bearings normally requiring grease, replace the oil with the grease specified for the bearings. Until this is done, shorten the frequency of the lubrication services.

b. The propeller shaft universal joints should not require any special lubrication attention. However, when performing the regular routine lubrication under such operating conditions, the universal joint needle bearings can be lubricated with any oil that will flow, but it must be replaced when the temperatures justify a change.

40. PROTECTION OF COOLING SYSTEM.

a. **ETHYLENE GLYCOL** (Prestone) is recommended for use as an antifreeze solution. However, where **ETHYLENE GLYCOL** is not available, **ALCOHOL**, denatured, may be used. The following table gives the proportions of **ETHYLENE GLYCOL** or **ALCOHOL** which must be used in protecting the cooling system against freezing at various temperatures:

Cooling System Capacity	10½ U. S. qt				8¾ Imp. qt			
	+20 F	+10 F	0 F	-10 F	-20 F	-30 F	-40 F	-50 F
ETHYLENE GLYCOL (Prestone)								
U. S. qt	2	2	3.5	4	4.5	5	6	6.5
Imp. qt	1.66	2.5	2.91	3.38	3.75	4.14	5	5.4
ALCOHOL, denatured								
U. S. qt	2	3	4	4.5	5	6	6.5	7.5
Imp. qt	1.66	2.5	3.38	3.75	4.14	5	5.4	6.25

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b. Before Installing Antifreeze Solution.

(1) Flush the cooling system thoroughly by flushing the radiator and cylinder block separately to avoid any transfer of sediment from one to the other. When possible, flush the cylinder block and radiator in the opposite direction to which the coolant normally flows. It is also a good plan to flush separately the heater for the battery compartment.

(2) Replace loose or collapsed hoses, coat the interior ends of the hose with LEAD, white, basic-carbonate, and tighten the hose clamps securely.

(3) Check the fan belt, replace it if necessary, and adjust the belt tension (par. 74 d).

(4) Make sure no leaks are present at the water pump, cylinder head, battery heater, or expansion plugs. Eliminate any leaks found.

(5) If a suitable container is available, mix the antifreeze solution before installing it in the cooling system; otherwise, pour in small amounts at a time to thoroughly mix the solution within the system.

(6) Run the engine for 10 minutes at a fast idle speed to circulate and agitate the mixture.

41. ELECTRICAL SYSTEM.

a. **Generator and Starter.** Check the brushes, commutators, and bearings. Cold weather starting requires a clean starter commutator and brushes. To keep the battery up to operating efficiency, the generator commutator and brushes must be clean, with good brush to commutator contact.

b. **Wiring.** Clean and tighten all electrical connections. Remove any corrosive deposits from the battery connections and wipe the top of the battery clean.

c. **Coil and Condenser.** Check to be sure the ignition coil and ignition distributor condenser are functioning properly.

d. **Distributor.** Keep the distributor and cap clean both inside and out. Keep the breaker points clean and adjusted properly at 0.020 inch (par. 60, b). Replace the points when necessary.

e. **Spark Plugs.** The spark plugs should be cleaned and adjusted frequently. Because of lower battery and coil efficiency in extremely cold weather, the spark plug gap clearance must be set accurately at 0.025-inch (par. 59, b).

f. **Ignition Timing.** Keep the timing in proper adjustment and check it frequently (par. 60, c).

g. **Battery.** Ordinarily, the efficiency of a battery will decrease to nothing at temperatures below -40 F. However, this vehicle is equipped with a 12-volt system and the battery compartment is lined with special insulation material. Also, the battery is kept warm during vehicle

OPERATION UNDER UNUSUAL CONDITIONS

operation by a heater coil connected into the cooling system, and the exhaust muffler is located to the left of the battery compartment. Thus, relatively quick engine starts may be made in temperatures of -40° F , provided the engine is kept free with the diluter and the battery is maintained in a fully charged state. Test the battery frequently with a hydrometer. A fully charged battery will test between 1.275 and 1.300. If the battery is kept fully charged it is unlikely that it will freeze within the heated and insulated compartment, but a completely discharged battery will freeze at $+5^{\circ}\text{ F}$.

h. **Lamps.** The lamp wire and ground connections must be clean and tight at all times to avoid high resistance at these points.

i. **Starting.** Before using the starter make sure the engine prestarting inspection (par. 6) has been followed closely and that there is no ice on the spark plugs and engine electrical equipment. Also, in extremely low temperatures the engine should be cranked by hand to save the battery for an ignition spark of high intensity. When the starter is cold, keep the switch button in contact for not more than 30 seconds at a time.

42. STARTING AND OPERATION.**a. Temperatures from -10° F to -40° F .**

(1) If all of the engine adjustments are established correctly, the oil has been diluted, the primer is used, and the battery is fully charged, a start is possible in a temperature of -40° F .

(2) See to it that the engine is in readiness for starting and follow the starting instructions (par. 8). When the engine begins to fire, attempt to keep it running. In addition, at very low temperatures it is necessary to use the primer all during the time of the start; and even after the engine is running it is sometimes necessary to continue the manual priming action. Do not make the mistake of opening the carburetor choke valve (pushing in on the button) too quickly. If the engine fires for a few revolutions and then stops, water (a natural product of combustion) will form on the cold inner surfaces of the engine and turn to frost. Obviously, such a condition will add greatly to the difficulty of starting.

(3) After the engine is running normally and the carburetor choke has been readjusted, operate the engine at a fast idle speed until the normal operating temperature of the engine is reached, as registered on the heat indicator gage. Adjust and readjust the rear air duct lid as required.

(4) After the engine is warmed thoroughly, operate the vehicle first at slow speeds in order to agitate and circulate the oil in the transmission and axle.

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b. Temperatures Below -40 F.

(1) When the vehicle has been exposed to extremely low temperatures for any length of time, it will be necessary to heat the oil pan, battery, manifold, and the fuel. When possible use a fully charged battery that has been stored in a protected place. Even in such a case it is not practical to use the battery for cranking the engine. If the attempt to hand crank the engine fails, tow the vehicle.

(2) As has been discussed previously, it would be better for the vehicle and save time if the engine were started at frequent periodic intervals all through the period of the halt. Such a procedure keeps the battery and engine compartments warm and makes starting a relatively simple operation.

c. Stopping.

(1) Before stopping the engine, operate the diluter using the amount of gasoline diluent recommended for the temperature being encountered (par. 56, i).

(2) Increase the engine speed, turn the ignition switch off, and let the engine come to a stop on an open throttle. This practice will not only blow out all residual products of combustion, but the cylinders will be filled with a clean full charge of combustible mixture.

43. COLD WEATHER ACCESSORIES.

a. It is desirable to employ a tent or large tarpaulin in connection with external heat supplied by a fire, portable stove, or some other means. Using the cover to keep the heat from the fire or the stove around the engine and to keep the wind out, the engine can be started readily when all other cold weather precautions have been taken. Means of providing external heat or even a shelter or cover are not always available, therefore, this suggestion is made only as a reminder that every aid available should be used to decrease the hazards of extremely low temperature operation.

b. It will be found desirable to have extra fully charged batteries available.

c. A close check on the rear air duct lid must be kept to keep the cooling system at its normal operating temperature while the engine is in operation. The cover should be fully closed while the engine is being started.

Section IX

MATERIEL AFFECTED BY CHEMICALS

	Paragraph
General	44
Protective measures	45
Decontamination	46
Special precautions for automotive materiel	47

44. GENERAL.

a. Gas clouds, chemical shell, and chemical spray are the major chemical warfare methods for destroying or damaging materiel. Removing or destroying the dangerous liquid or solid chemical agents spread by these methods, or changing these chemical agents to harmless substances is called decontamination.

45. PROTECTIVE MEASURES.

a. When materiel (except ammunition) is in constant danger of attack with chemicals, apply a light coat of seasonal grade engine oil to unpainted metal parts. Take care that the oil does not touch the optical parts of instruments, or leather or canvas fittings. Protect materiel not in use with covers as far as possible. Keep ammunition in sealed containers.

b. Ordinary fabrics offer practically no protection against mustard gas or lewisite. Rubber and oilcloth, for example, will be penetrated within a short time. The longer the period of exposure, the greater the danger, when apparel made of either of these materials is worn. Rubber boots contaminated with mustard gas may offer a grave danger to men who wear them several days after the attack. Impermeable clothing, designed to prevent penetration of chemicals, will resist penetration almost indefinitely, but the maximum time such clothing can be worn is from 5 to 10 minutes in summer and about 30 minutes in winter.

46. DECONTAMINATION.

a. For the removal of liquid vesicants (mustard, lewisite, etc.) from materiel, the following steps should be taken:

b. Protection of Personnel.

(1) For all of these operations a service gas mask and a complete suit of protective clothing, either permeable or impermeable depending upon the type of contamination, must be worn. Immediately after removing the suit, a thorough bath with soap and water (preferably hot) must be taken. If any skin areas have come in contact with liquid or vapor mustard gas, or if the vapor of mustard has been inhaled, it is imperative that complete first-aid measures be given within 5 minutes to be effective

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as a preventive. First aid must be prompt for little can be done later than 20 to 30 minutes after exposure.

(2) Casualties caused by vesicants (mustard, lewisite, etc.) or by lung irritants (phosgene, all vesicants, etc.) should be immediately removed from the contaminated area.

(a) *Vesicant Casualties.* Remove the contaminated clothing. If the face has been exposed, wash the eyes and rinse the nose and throat with a saturated boric acid, weak sodium bicarbonate, or common salt solution. Mustard burns or skin areas wet with liquid mustard should be immediately and repeatedly swabbed with a solvent, such as kerosene, any oil, alcohol, or carbon tetrachloride. Then wash thoroughly with soap and water.

(b) *Lung Irritant Casualties.* To reduce his oxygen requirements, make the casualty lie down. Keep him warm and give him nonalcoholic stimulants such as hot coffee or tea. He should be evacuated as soon as possible as an absolute litter case.

(c) Complete first-aid instructions to supplement the above general instructions are contained in FM 21-40.

(3) Decontaminate garments exposed to vesicants. If impermeable clothing has been exposed to vapor only, it may be decontaminated by hanging in the open air, preferably in sunlight, for several days. It may also be cleaned by steaming for 2 hours. If impermeable clothing has been contaminated with liquid vesicant gases, steam it for 6 to 8 hours. Various kinds of steaming devices can be improvised from equipment available in the field.

c. Procedure.

(1) Commence by freeing materiel of dirt through the use of sticks, rags, etc. Sticks, rags, and other cleaning items used in decontamination must be burned or buried immediately after their use.

(2) If the surface of the materiel is coated with grease or heavy oil, remove it before decontamination is begun. For this cleaning use SOLVENT, dry-cleaning, or other available solvents for oil, applied on rags attached to the ends of sticks.

(3) Decontaminate the painted surfaces of the materiel with bleaching mixture made by mixing equal parts by weight of AGENT, decontaminating (chloride of lime), and water. So large a proportion of bleaching powder is added to the water that only a small part is dissolved; therefore a suspension, or "slurry" is formed. This slurry should be swabbed over all surfaces. Wash off thoroughly with water, then dry and oil all surfaces.

(4) All unpainted metal parts of materiel that have been exposed to any gas except mustard and lewisite must be cleaned as soon as possible with SOLVENT, dry-cleaning, or ALCOHOL, denatured, and wiped dry.

All parts should then be coated with oil.

MATERIEL AFFECTED BY CHEMICALS

(5) All unpainted metal parts and instruments exposed to mustard or lewisite must be decontaminated with AGENT, decontaminating, noncorrosive, mixed one part solid to 15 parts solvent (ACETYLENE TETRACHLORIDE) by weight. If this is not available, use warm water and soap. Bleaching slurry must not be used, because of its corrosive action on unpainted metal parts. After decontamination, wipe all metal surfaces dry and coat them lightly with engine oil, except the surfaces of small arms, which must be coated with OIL, lubricating, preservative, light. Instrument lenses may be cleaned only with PAPER, lens, tissue, using a small amount of ALCOHOL, ethyl.

(6) If AGENT, decontaminating (chloride of lime) is not available, materiel may be temporarily cleaned with large volumes of hot water. However, mustard gas lying in joints or in leather or canvas webbing is not removed by this procedure and will remain a constant source of danger until the materiel can be properly decontaminated. Because all mustard gas washed from materiel lies unchanged on the ground, the area should be plainly marked with warning signs before abandonment.

(7) Leather or canvas webbing that has been contaminated should be scrubbed thoroughly with bleaching slurry. If this treatment is believed insufficient, it may be necessary to burn or bury such materiel.

(8) Ammunition which has been exposed to vesicant gas must be thoroughly cleaned before firing. To clean ammunition use AGENT, decontaminating, noncorrosive, or if this is not available, strong soap and warm water. After cleaning, wipe all ammunition dry with clean rags. *Do not use dry powdered AGENT, decontaminating (chloride of lime) (used for decontaminating certain types of materiel on or near ammunition supplies)*, as flaming occurs when it touches liquid mustard.

(9) Detailed information on decontamination is contained in FM 21-40 and TM 3-220.

47. SPECIAL PRECAUTIONS FOR AUTOMOTIVE MATERIEL.

a. When a vehicle has been subjected to gas attack with the engine running, service the air cleaner by removing the oil, flushing with SOLVENT, dry-cleaning, and refilling with the proper grade of oil.

b. Instrument panels should be cleaned in the same manner as instruments.

c. Discard contaminated seat cushions.

d. Washing the compartments thoroughly with bleaching slurry is the most that can be done in the field. In warm weather, operators should constantly be on the alert for slow vaporization of the mustard or lewisite.

e. Decontaminate the exterior surfaces of the vehicle with bleaching slurry. Repainting may be necessary after this operation.

PART TWO—Organization Instructions

Section X

GENERAL INFORMATION ON MAINTENANCE

	Paragraph
Organization maintenance	48

48. ORGANIZATION MAINTENANCE.

a. **Scope.** The scope of maintenance and repair by the crew and other units of the using arms is determined by the availability of suitable tools, availability of necessary parts, capabilities of the mechanics, time available, and the tactical situation. All of these are variable and no exact system of procedure can be prescribed.

b. **Allocation of Maintenance.** Indicated below are the maintenance duties for which tools and parts have been provided for the using arm personnel. Other replacements and repairs are the responsibility of ordnance maintenance personnel but may be performed by using arm personnel when circumstances permit, within the discretion of the commander concerned. Echelons and words as used in this list of maintenance allocations are defined as follows:

SECOND ECHELON: Line organization regiments, battalions, companies, detachments, and separate companies.

THIRD ECHELON: Ordnance light maintenance companies, ordnance medium maintenance companies, ordnance divisional maintenance battalions, and post ordnance shops.

FOURTH ECHELON: Ordnance heavy maintenance companies, and service command shops.

FIFTH ECHELON: Ordnance base regiments, ordnance bases, arsenals, and manufacturers' plants.

SERVICE (Including preventive maintenance): Refer to AR 850-15, paragraph 23 a (1) and (2). Consists of servicing, cleaning, lubricating, tightening bolts and nuts, and making external adjustments of subassemblies or assemblies and controls.

REPLACE: Refer to AR 850-15, paragraph 23 a (4). Consists of removing the part, subassembly or assembly from the vehicles and replacing it with a new or reconditioned or rebuilt part, subassembly or assembly, whichever the case may be.

GENERAL INFORMATION ON MAINTENANCE

REPAIR: Refer to AR 850-15, paragraph 23 a (3) and (5), in part. Consists of making repairs to, or replacement of the part, subassembly or assembly that can be accomplished without completely disassembling the subassembly or assemblies, and does not require heavy welding, or riveting, machining, fitting and/or alining or balancing.

REBUILD: Refer to AR 850-15, paragraph 23 a (5), in part, and (6). Consists of completely reconditioning and replacing in serviceable condition any unserviceable part, subassembly or assembly of the vehicle, including welding, riveting, machining, fitting, alining, balancing, assembling and testing.

NOTE: Operations allocated will normally be performed in the echelon indicated by "X." Operations allocated to the echelons as indicated by "E" may be accomplished by the respective echelons in emergencies only.

	ECHELONS
	2nd 3rd 4th 5th
CLUTCH ASSEMBLY	
Clutch assembly—service, adjust and replace	x
Clutch assembly—repair	x
Clutch assembly—rebuild	E x
CONTROLS AND LINKAGE	
Controls and linkage [clutch, steering, transmission, throttle, transmission (high and low range)]—replace	x
Controls and linkage [clutch, steering, transmission, throttle, transmission (high and low range)]—repair	x
COOLING SYSTEM	
Radiator assembly—replace	x
Radiator assembly—repair	x
Radiator assembly—rebuild	E x
DIFFERENTIAL AND TRANSMISSION (HIGH AND LOW RANGE)	
Bands, brake—service (adjust)	x
Bands, brake—replace, repair and reline	x
Differential and transmission (high and low range) assembly—replace	x
Differential and transmission (high and low range) assembly—repair	x
Differential and transmission (high and low range) assembly—rebuild	E x
ELECTRICAL SYSTEM	
Battery—replace	x

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	2nd	3rd	4th	5th
Battery—repair				x
Battery—rebuild			e	x
Box, apparatus assembly (generator control)— replace			x	
Box, apparatus assembly (generator control)— repair			x	
Box, apparatus assembly (generator control)— rebuild				x
Cables and connections, battery—replace	x			
Cables and connections, battery—repair	e	x		
Defroster assembly—replace and repair	x			
Lights (all)—service and replace	x			
Lights (all)—repair			x	
Switch, starter assembly—replace	x			
Switch, starter assembly—repair			x	
Wiper, windshield assembly—replace	x			
Wiper, windshield assembly—repair			x	
Wiper, windshield assembly—rebuild				x
Wiring, conduits and junction box—replace	x			
Wiring, conduits and junction box—repair			x	

ENGINE ASSEMBLY

Bearing, connecting rod—replace	e	e	x
Belts, generator and fan—adjust and replace	x		
Camshaft—rebuild (recondition)		e	x
Carburetor—replace	x		
Carburetor—repair		x	
Carburetor—rebuild			x
Cleaner, air assembly—service and replace	x		
Cleaner, air assembly—repair		x	
Crankshaft—rebuild (recondition)		e	x
Dilution system, engine oil—replace	x		
Dilution system, engine oil—repair		x	
Engine assembly—replace	*	x	
Engine assembly—repair		x	
Engine assembly—rebuild		e	x
Fan assembly—replace	x		
Fan assembly—repair		x	
Fan assembly—rebuild			x
Filter assembly, fuel and lines—service and replace	x		

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GENERAL INFORMATION ON MAINTENANCE

	2nd	3rd	4th	5th	ECHELONS
Filter assembly, fuel and lines—repair				x	
Flywheel assembly—replace		x			
Flywheel assembly—repair		x			
Flywheel assembly—rebuild (recondition)				x	
Gaskets (oil pan, cylinder head, manifold)—replace	x				
Gear, timing—replace			x		
Generator assembly—replace		x			
Generator assembly—repair			x		
Generator assembly—rebuild				x	
Head, cylinder assembly—replace		x	x		
Head, cylinder assembly—repair				x	
Head, cylinder assembly—rebuild (recondition)			x	x	
Lines, oil and connection, internal—replace and repair				x	
Manifold, exhaust and intake assembly—replace	x				
Manifold, exhaust and intake assembly—repair		x			
Motor, starting assembly—replace	x				
Motor, starting assembly—repair			x		
Motor, starting assembly—rebuild				x	
Pan, oil assembly—service (clean)	x				
Pan, oil assembly—replace and repair			x		
Pipe, exhaust—replace		x			
Pipe, exhaust—repair			x		
Piston assembly—replace		x	x	x	
Pump, fuel assembly—replace	x				
Pump, fuel assembly—repair		x			
Pump, fuel assembly—rebuild				x	
Pump, oil assembly—replace and repair		x			
Pump, oil assembly—rebuild				x	
Pump, water assembly—replace	x				
Pump, water assembly—repair		x			
Pump, water assembly—rebuild				x	
Thermostat—replace	x				

IGNITION (ENGINE ASSEMBLY)

Coil, ignition—replace	x
Condenser, distributor—replace	x
Distributor and cap assembly—replace	x
Distributor assembly—repair	x
Distributor assembly—rebuild	x
Plugs, spark—replace	x

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	2nd	3rd	4th	5th	ECHELONS
Plugs, spark (2 piece)—repair				x	
Points, distributor breaker—replace			x		
					EXTINGUISHER, FIRE SYSTEM
Extinguisher, fire—replace and recharge			x		
Extinguisher, fire—repair			x		
Extinguisher, fire—rebuild					E x
					FUEL SYSTEM
Lines and connections—replace			x		
Lines and connections—repair		E	x		
Pump, primer assembly—replace		x			
Pump, primer assembly—repair			x		
Pump, primer assembly—rebuild				x	
Tank, fuel—replace	x				
Tank, fuel—repair			x		
					FINAL DRIVE ASSEMBLY
Final drive assembly—replace	x				
Final drive assembly—repair			x		
Final drive assembly—rebuild					E x
Hub assembly—replace	x				
Hub assembly—repair			x		
Hub assembly—rebuild					E x
Shaft, axle—replace	x				
Shaft, axle—repair			x		
Shaft, axle—rebuild (recondition)					E x
Sprocket, wheel assembly—replace	x				
Sprocket, wheel assembly—repair			x		
Sprocket, wheel assembly—rebuild					E x
					HULL
Hull assembly—repair			x		
Hull assembly—replace				x	
Hull assembly—rebuild				E	x
Seat—replace	x				
Seat—repair			x		
					INSTRUMENT AND GAGES
Instruments and gages—replace	x				
Instruments and gages—repair			x		
Instruments and gages—rebuild					E x
					LUBRICATION SYSTEM
Lines, oil and connections, external—replace	x				
Lines, oil and connections, external—repair			x		
					SHAFT PROPELLER
Shaft, propeller and universal joints—replace	x				
Shaft, propeller and universal joints—repair			x		
Shaft, propeller and universal joints—rebuild					

Original from x

GENERAL INFORMATION ON MAINTENANCE

	2nd	3rd	4th	5th
SUSPENSION SYSTEM				
Arm, idler rocker—replace			x	
Arm, idler rocker—repair			x	
Arm, idler rocker—rebuild				E x
Axle, rear assembly—replace and repair		x		
Axle, rear assembly—rebuild			E	x
Bearing (Oilite) track supporting roller—replace and repair			x	
Bearings and seals, bogie wheel and idler—replace	x			
Brackets, bogie assembly—replace and repair		x		
Bracket, bogie assembly—rebuild			E	x
Components, bogie—replace	x			
Components, bogie—repair		x		
Components, bogie—rebuild			E	x
Roller, track supporting—replace	x			
Roller, track supporting—repair		x		
Roller, track supporting—rebuild			E	x
Track assembly—replace and repair	x			
Track assembly—rebuild			E	x
Wheel, bogie and idler—replace	x			
Wheel, bogie and idler—repair		x		
Wheel, bogie and idler—rebuild			E	x
TRANSMISSION ASSEMBLY				
Transmission assembly—replace	*	x		
Transmission assembly—repair		x		
Transmission assembly—rebuild			E	x
VEHICLE ASSEMBLY				
Carrier, cargo—rebuild (with serviceable assemblies)		x		E
Carrier, cargo—service		x		

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Section XI

TOOLS AND EQUIPMENT

	Paragraph
Special tools	49
Fire extinguisher	50

49. SPECIAL TOOLS.

CLAMP, universal joint	HKMJ881A
EYEBOLT, engine lifting	HKMJ53
FEELER, tappet, stock	SDAC300
GAGE, alining, clutch	MPF6A
GAGE, compression	AEEG4
GAGE, gap spark plug, dial	UMS40
HYDROMETER	EDL40
INDICATOR, dial, test	SBSS196
LIGHT, timing	WEZ892
REPLACER, bogie wheel bearing	BKMJ270
SCALE, spring	HKMJ544S
TOOL, alining, distributor point	AEE38
WRENCH, combination, electric, set	WMS1285P
WRENCH, drive and rear wheel bearing nut	SD903856
WRENCH, tappet, 1/2-in.	WMS1090
WRENCH, tension	AMM1

50. FIRE EXTINGUISHER.

- a. A one-quart pump type fire extinguisher is carried on a bracket on the cockpit side of the engine compartment bulkhead. A retaining strap with an easily unlatched catch is used to keep the fire extinguisher tight in its bracket. To use the fire extinguisher, pull out on the catch to loosen the retaining strap and pull the extinguisher off its mounting bracket, turn the handle 90 degrees counterclockwise to unlock the pump, and pull the handle rearward. Pushing in on the handle forces a stream of fire extinguishing chemical from the nozzle. By pumping the handle a continuous stream will be forced from the nozzle. The stream should always be directed at the base of the flame. After the blaze has been extinguished, continue to play a stream on the surrounding area. After using the extinguisher always make sure the handle is pushed all the way in and turned clockwise 90 degrees to lock the handle in the head and close the nozzle valve. If this is not done the fluid will leak. The fire

TOOLS AND EQUIPMENT

extinguisher can be used to put out a fire in the engine compartment even though the engine is running.

b. After the fire extinguisher has been used, refill it at the first opportunity with the proper fluid (CARBON TETRACHLORIDE). After filling, make sure it does not leak after the valve has been turned completely off. Replace a leaking extinguisher. The extinguisher is filled by removing the filler plug in the head. Use a small funnel when pouring in fluid to prevent waste. To discourage tampering, the driver should seal the filler plug and check this seal during inspections.

c. In an emergency, the extinguisher fluid (CARBON TETRACHLORIDE) will prove to be invaluable in drying off spark plugs, the ignition coil, distributor, etc. When wiring and ignition units have become thoroughly wet and time does not permit systematic drying with rags or heat, the CARBON TETRACHLORIDE will absorb moisture without harming the ignition apparatus or engine.

Section XII

ORGANIZATION SPARE PARTS AND ACCESSORIES

	Paragraph
Organization spare parts	51
Accessories	52

51. ORGANIZATION SPARE PARTS.

a. A set of organization spare parts is supplied to the using arm for field replacement of those parts most likely to become broken, worn, or otherwise unserviceable. The set is kept complete by requisitioning new parts for those used. Organization spare parts are listed in pertinent SNL'S.

52. ACCESSORIES.

a. Accessories include tools and equipment required for such disassembling and assembling as the using arms are authorized to perform, and for the cleaning and preservation of the armament, ammunition, etc. They also include storage compartments, covers, tool rolls, and other items necessary to protect the materiel when it is not in use, or when traveling. Accessories should not be used for purposes other than as prescribed, and when not in use should be properly stored.

Section XIII

ENGINE

	Paragraph
Description and tabulated data	53
Trouble shooting	54
Engine removal	55
Lubrication	56
Cylinder head and manifold	57
Exhaust system	58
Spark plugs	59
Ignition system	60
Carburetor	61
Oil pressure gage	62
Valves	63
Generator	64
Starting motor	65
Engine installation	66

53. DESCRIPTION AND TABULATED DATA.

a. **Description.** This vehicle is powered with a 6-cylinder, L-head, liquid-cooled engine. The fan end of the engine will be referred to as the rear of the engine and the clutch end as the front end of the engine. The manifold side will be referred to as the left side, and the generator side as the right side of the engine. The cylinder head, block, and crankcase are of grey iron. The fan, fan belt, water pump, generator, fuel pump, ignition distributor, oil filter, air cleaner, diluter, manifold heat control valve, carburetor and spark plugs are accessible on raising the engine compartment lid (figs. 16, 17, and 18).

b. Tabulated Data.

Make	Studebaker
Model	Champion
Type	L-head
Bore	3 in.
Stroke	4 in.
Displacement	170 cu in.
Compression ratio	7 to 1
Horsepower (net)	70 at 3,800 rpm
Crankcase capacity	5 qt
Cooling system capacity	10½ qt
Weight (with accessories)	418 lb

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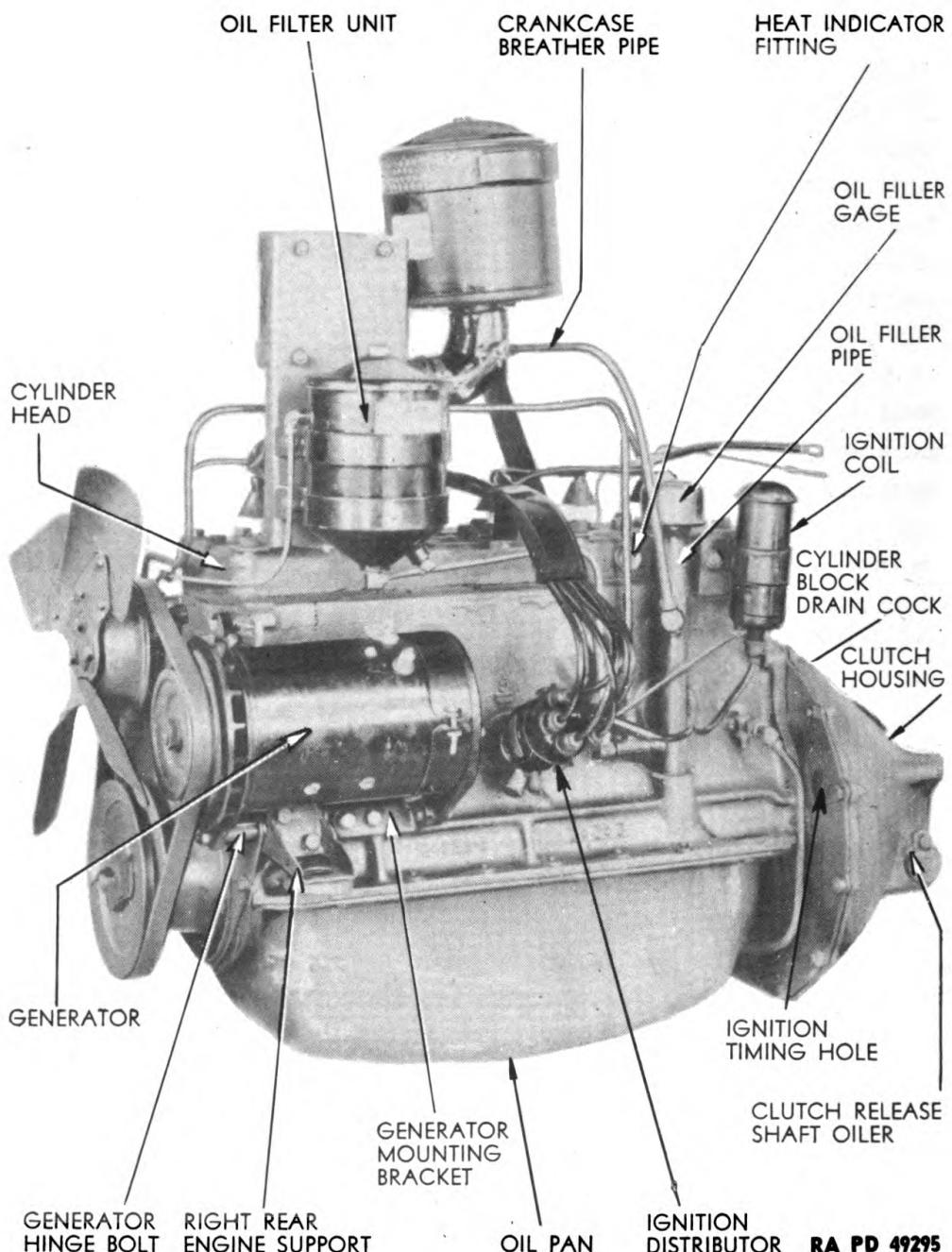


Figure 16—Engine Right Side

54. TROUBLE SHOOTING.

a. Starter Will Not Crank Engine.

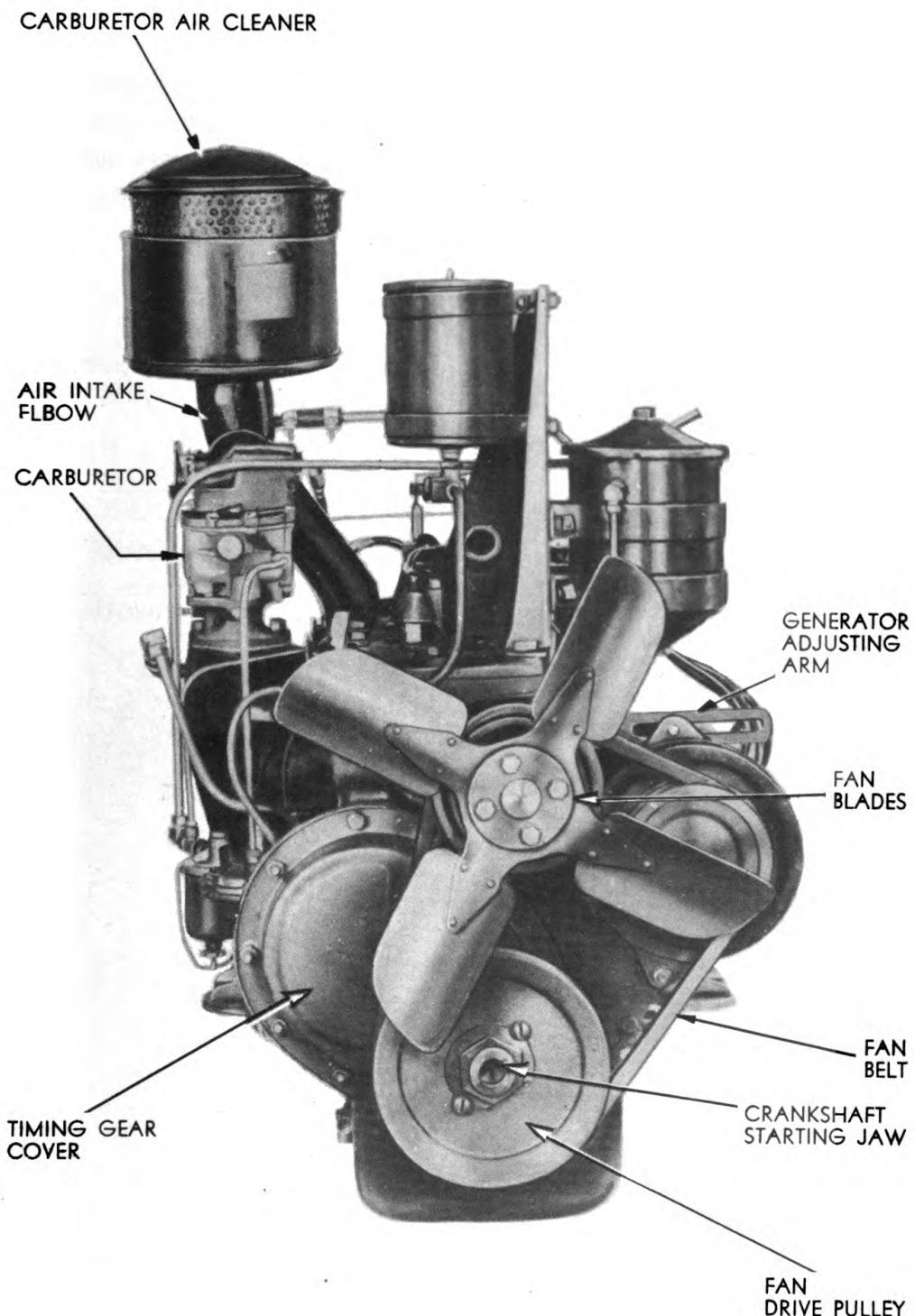
Probable Cause

Ineffective ground at starter switch
(on instrument panel).

Probable Remedy

If operation is restored by removing cap on top of starter solenoid switch and depressing plunger, replace switch (par. 112 a).

ENGINE



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Figure 17—Engine Rear

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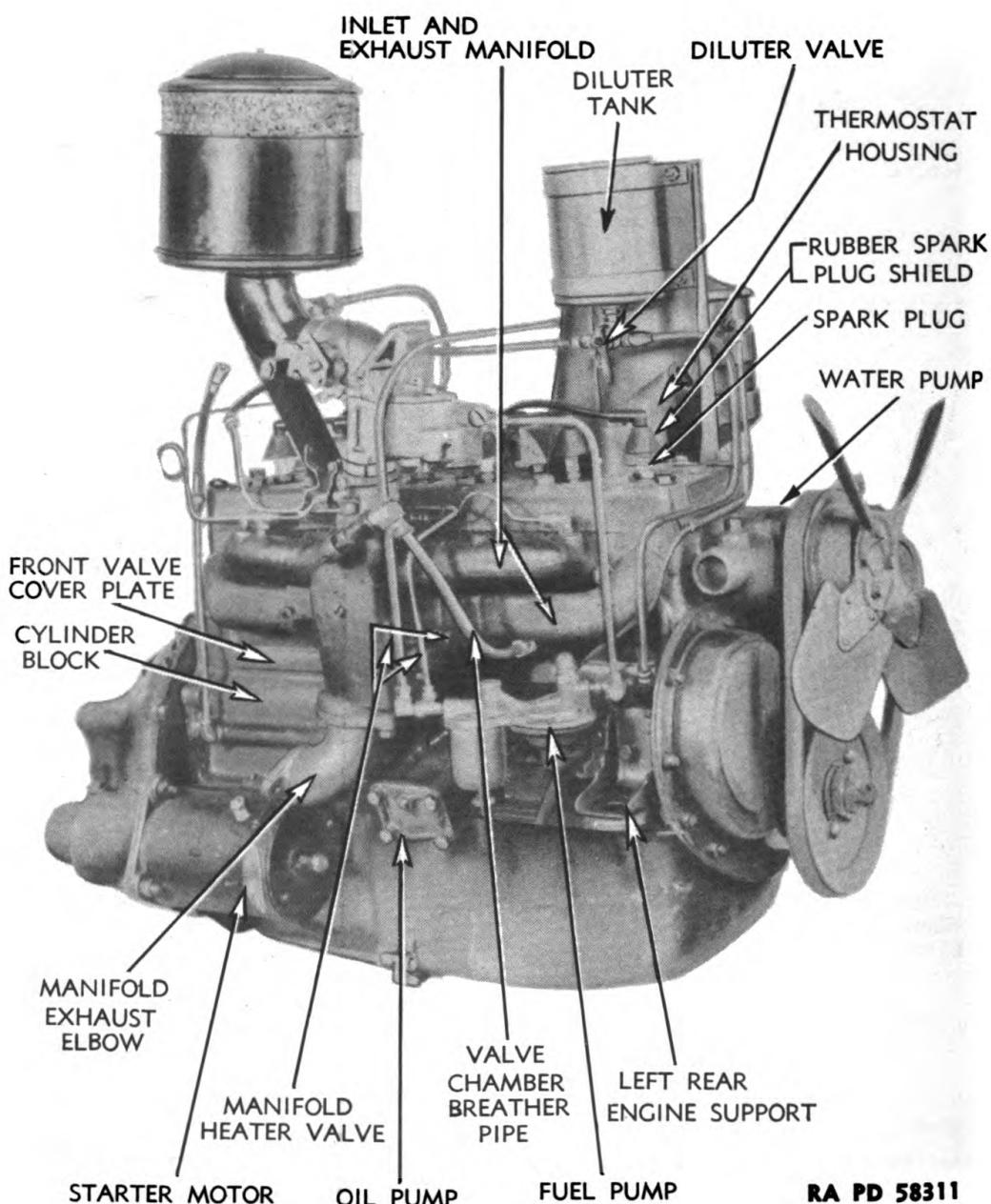
Probable Cause

Ineffective ground or internal difficulty at starter solenoid switch on rear of engine compartment bulkhead.

Discharged battery.

Probable Remedy

If starter switch button is pushed and click cannot be heard as solenoid operates, replace solenoid switch (par. 111 d (1)). Charge or replace battery after noting voltmeter reading and checking with hydrometer (par. 109 b and c).



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Figure 18—Engine Left Side

ENGINE

Probable Cause	Probable Remedy
Loose connection in starter circuit.	If lights go dim or out on pressing starter switch button, check and tighten all starter and switch connections (par. 131).
Starter inoperative, shorted, or grounded.	Replace starter motor (par. 65 c).
High internal or external engine resistance to starting.	Check battery condition and connections (par. 109 b). If engine oil is too heavy, drain and replace it with oil of proper grade (par. 24 b).
b. Engine Cranks but Fails to Start.	
Starter cranking speed too slow.	Replace starter motor (par. 65 c), or recharge battery (par. 109).
Carburetor choke valve disconnected from control or control improperly adjusted.	Connect choke or adjust control (par. 61 a (3)).
Carburetor may be flooded.	Crank engine, holding throttle wide open to clear out flooded condition.
No current getting to spark plugs.	If strong spark occurs when end of wire is held $\frac{1}{4}$ inch from plug while cranking, service or replace plugs (par. 59).
No primary current due to faulty ignition switch or bad connection.	Replace switch (par. 113 d) or tighten loose connection (par. 131).
Spark plug wire or coil wire wet, disconnected or shorted.	Dry out, properly connect, or replace.
Distributor cap or coil cover wet, loose, cracked, or broken.	Dry out, reinstall, or replace.
Condenser or coil very weak or inoperative.	If a red spark appears, substitute condenser (par. 60 b (3) (d)) and coil (par. 60 d) and replace one or both as required.
Distributor contact points dirty or burned.	If points are burned, pitted, iced, or misaligned, clean and adjust or replace points (par. 60 b).
Ignition timing out of adjustment.	Check and adjust timing (par. 60 c).

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Probable Cause

No fuel in carburetor.

Probable Remedy

If check shows tank contains fuel, disconnect fuel pump pipe at carburetor and operate pump hand lever. If fuel flows properly, tap the carburetor float bowl to dislodge the float.

Clogged fuel pump.

Clean pump strainer screen and bowl (par. 69 c); also clean carburetor screen (par. 69 d).

Fuel pipe clogged or fuel pump valves closed.

Remove, clean, and reinstall pipe (par. 69 b) or replace fuel pump (par. 70).

Carburetor dirty, out of adjustment, or iced.

Replace carburetor (par. 61 b).

e. Engine Stops.

Ignition connections loose or broken.

Tighten or replace wires or connections (par. 131).

Faulty fuel connections.

Tighten or replace pipes or units as necessary.

d. Engine Operates Unevenly.

Choke valve partially closed.

Open choke valve or adjust as required (par. 61 a (3)).

One or more spark plugs misfiring, broken, fouled, or disconnected. Secondary wire or wires burned, broken, wet, or leaking through faulty insulation.

Clean, adjust, test, or replace plug (par. 59).

Ignition timed incorrectly.

Repair or replace secondary cables as required.

Carburetor adjusted incorrectly (external adjustment).

Check and adjust timing (par. 61).

Carburetor out of adjustment internally or passages clogged or worn.

Adjust throttle stop and idle mixture screws (par. 61 a (2)).

Air leak at intake manifold or between carburetor and manifold.

Replace carburetor (par. 61 b).

Cylinder head gasket leaking.

Correct leaks by tightening or replace gaskets as required (par. 57 b (7) and 61 b).

One or more valves sticking or rings worn, permitting excessive blow-by.

Listen for air leaks or for popping in carburetor or muffler. Replace gasket (par. 57 b).

If engine compression does not check satisfactorily (par. 63 b), replace engine (par. 66).

ENGINE

Probable Cause	Probable Remedy
Manifold heat control valve seized.	Free manifold valve operation (par. 61 a (1)).
e. Engine Overheats.	
Low coolant supply.	Add coolant (par. 77 d (5)) and check and correct any leaks at radiator, battery heater pipes, cylinder head, engine freeze plugs, water pump shaft, hose connections, heat indicator fitting, and radiator drain valve and pipe.
Fan belt loose or broken.	Replace belt or adjust belt tension as required (par. 74 f).
Engine water thermostat sticking.	Replace thermostat (par. 75 d).
Low engine oil level.	Restore oil level in oil pan with proper grade oil.
Ignition timing late.	Check and adjust timing (par. 60 e).
Water pump not functioning.	Replace pump (par. 77).
f. Light Knock or Ping on Acceleration.	
Improper timing, low grade fuel, or excessive carbon deposits in engine.	Adjust timing (par. 60 e), adjust octane selector for fuel in use (par. 60 a (3) (a)), or remove carbon from cylinder head. (par. 57 b).
g. Light Clicking Noise Occurring at $\frac{1}{2}$ Crankshaft Speed.	
Excessive clearance at valve stems. (Noise will be intermittent if one or two valves are involved.)	Adjust valve push rod screws to proper valve stem clearance (par. 59 b) or replace engine (par. 55).
h. High Pitched Squeals.	
Under-lubricated water pump bearing.	Replace pump (par. 77).
Under-lubricated generator bearings.	Oil bearings or replace generator as required (par. 64 b (1) or 64 c).
Under-lubricated distributor shaft bearing.	Replace distributor (par. 60 a).
i. Pronounced Knock Occurring at Crankshaft Speed.	
Burned out connecting rod bearing.	Replace engine (par. 55).

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j. Heavy Thudding Noise at Crankshaft Speed.

Burned out main bearing. Replace engine (par. 55).

k. Metallic Clattering Sound on Acceleration Under Load.

Loose pistons. Replace engine (par. 55).

55. ENGINE REMOVAL.

a. Equipment.

BOLT, eye, engine lifting	WRENCH, box, $\frac{7}{16}$ -in.
HKMJ53 (2)	WRENCH, box, $\frac{1}{2}$ -in.
CHAIN, lifting	WRENCH, box, $\frac{9}{16}$ -in.
EXTENSION, socket	WRENCH, box, $\frac{5}{8}$ -in.
HANDLE, ratchet	WRENCH, box, $\frac{3}{4}$ -in.
HANDLE, speeder	WRENCH, open-end, $\frac{9}{32}$ -in.
HANDLE, socket	WRENCH, open-end, $\frac{3}{8}$ -in.
HOIST	WRENCH, open-end, $\frac{7}{16}$ -in.
LEAD, white, basic-carbonate	WRENCH, open-end, $\frac{1}{2}$ -in.
PAN, drain	WRENCH, open-end, $\frac{9}{16}$ -in.
PAPER	WRENCH, open-end, $\frac{5}{8}$ -in.
PLIERS	WRENCH, open-end, $\frac{3}{4}$ -in.
SCREWDRIVER	WRENCH, socket, $\frac{7}{16}$ -in.
WRENCH, box $\frac{3}{8}$ -in.	WRENCH, socket, $\frac{1}{2}$ -in.



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Figure 19—Removing Top from Vehicle

ENGINE



RA PD 49360

Figure 20—Front Seat Removal**WRENCH, socket, $\frac{1}{16}$ -in.****WRENCH, socket, $1\frac{1}{16}$ -in.****WRENCH, socket, $\frac{3}{4}$ -in.****WRENCH, socket, 1-in.****WRENCH, socket, universal,** **$\frac{1}{2}$ -in.****WRENCH, socket, universal,** **$\frac{7}{16}$ -in.****b. Remove Vehicle Top.****PLIERS**

Unfasten the wires on the vehicle top from the windshield frame and deck coaming, and remove the top (fig. 19). Take out the 4 cotter pins (pliers) and lift the 2 top bows out of the sockets welded to the inside deck coaming, noting that the bow having 4 eyelets at the top and middle is installed to the front.

c. Remove Seats.**PLIERS****WRENCH, open-end, $\frac{9}{16}$ -in.**

Unbuckle the seat cushion straps and remove the cushions. Take out the 4 bolts, flat washers, and lock washers ($\frac{9}{16}$ -in. open-end wrench) holding the front seat to the cockpit. Note the 3 possible front seat positions (fig. 20). Remove the seat from the cockpit (fig. 20). Take out the 4 cotter pins and clevis pins (pliers) holding the assistant driver's

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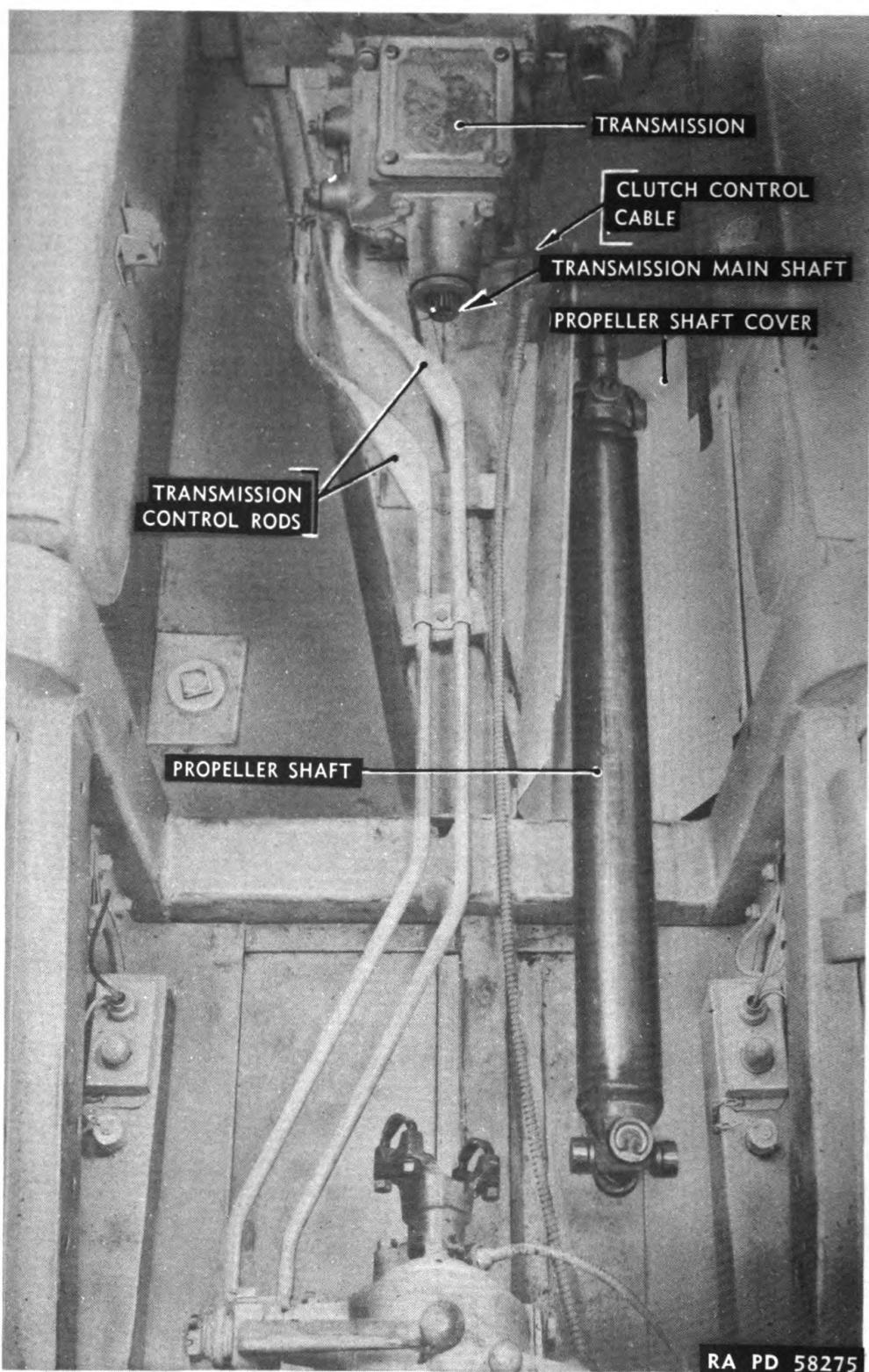
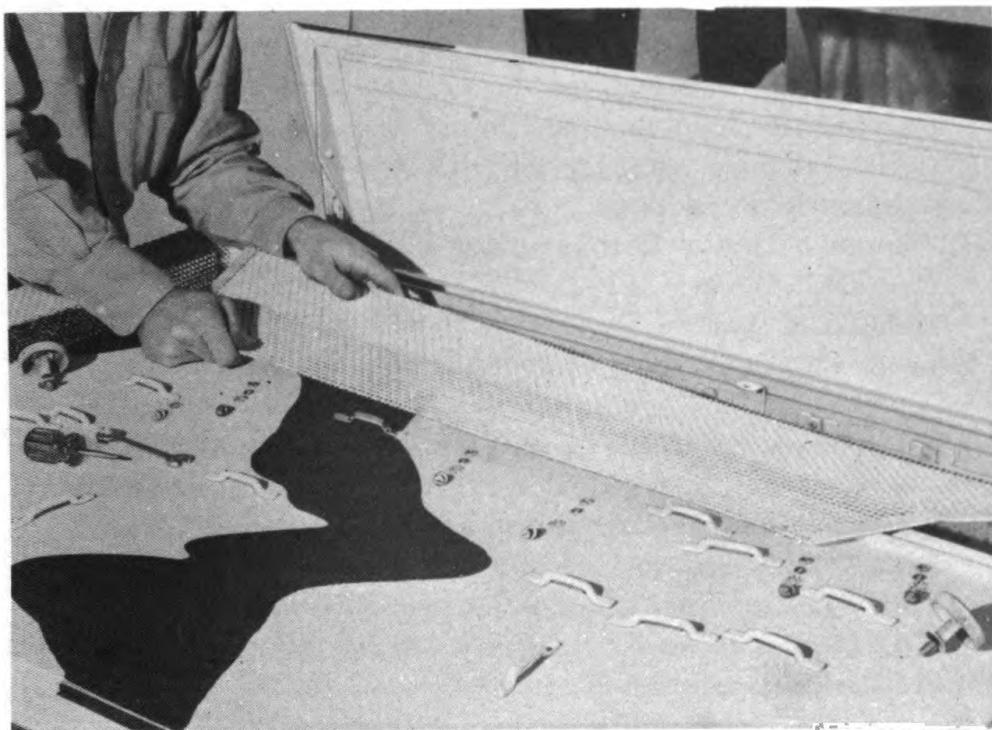


Figure 21—Transmission and Clutch Controls (Propeller Shaft and Cover Removed)

ENGINE



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Figure 22—Engine Compartment Front Screen Removal

seat to the cockpit side brackets. Lift the seat out of the brackets, tip it forward, and remove it from the cockpit.

d. Remove Propeller Shaft and Disconnect Transmission and Clutch Controls.

HANDLE, ratchet

WRENCH, box, $\frac{1}{2}$ -in.

PLIERS

WRENCH, socket, $\frac{7}{16}$ -in.

Remove the 4 cap screws ($\frac{7}{16}$ -in. socket and ratchet handle) with flat washers and lock washers and remove the propeller shaft cover. Note that the rectangular opening on one side of the cover goes to the right side. Remove the 4 U-bolt nuts ($\frac{1}{2}$ -in. box wrench) with lock washers at the front universal joint and move the propeller shaft assembly forward and off the transmission main shaft (fig. 21). Install a dummy flange or pack rags around the transmission main shaft to prevent lubricant leakage when the engine is raised. Disconnect the clutch and transmission remote control linkage by removing 3 cotter pins and clevis pins (pliers). Remove the clutch release shaft outer lever return spring.

e. Remove Engine Compartment Front Lid Screen.

SCREWDRIVER

WRENCH, open-end, $\frac{3}{8}$ -in.

Unscrew and remove the engine compartment front lid adjusting arm handwheel at each side, and move the lid to a completely raised position.

Remove the 3 machine screws that secure the front lid screen to brackets

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on the engine compartment lid hinge support, using a $\frac{3}{8}$ -inch open-end wrench to hold the nut below the bracket and a screwdriver to turn the screw extending through the screen (fig. 22). Note that a lock washer and flat washer are used between the nut and underside of the bracket; also, a double star washer is used between the screen and top side of the bracket to assure complete grounding at these points. Repeat the operation at the 3 screws holding the front of the screen to brackets on the compartment front lid hinge.

f. Remove Engine Compartment Lid.

HANDLE, ratchet **WRENCH, socket, $\frac{7}{16}$ -in.**

WRENCH, box, $\frac{7}{16}$ -in.

Remove the engine compartment lid and hinge support by taking out the 4 bolts and nuts ($\frac{7}{16}$ -in. box wrench, and $\frac{7}{16}$ -in. socket and ratchet handle), with lock washers (2 on each side), which hold the lid hinge to the deck coaming (fig. 23). Lift off the lid and hinge assembly.

g. Remove Engine Compartment Front Lid and Hinge.

EXTENSION, socket **WRENCH, socket, $\frac{7}{16}$ -in.**

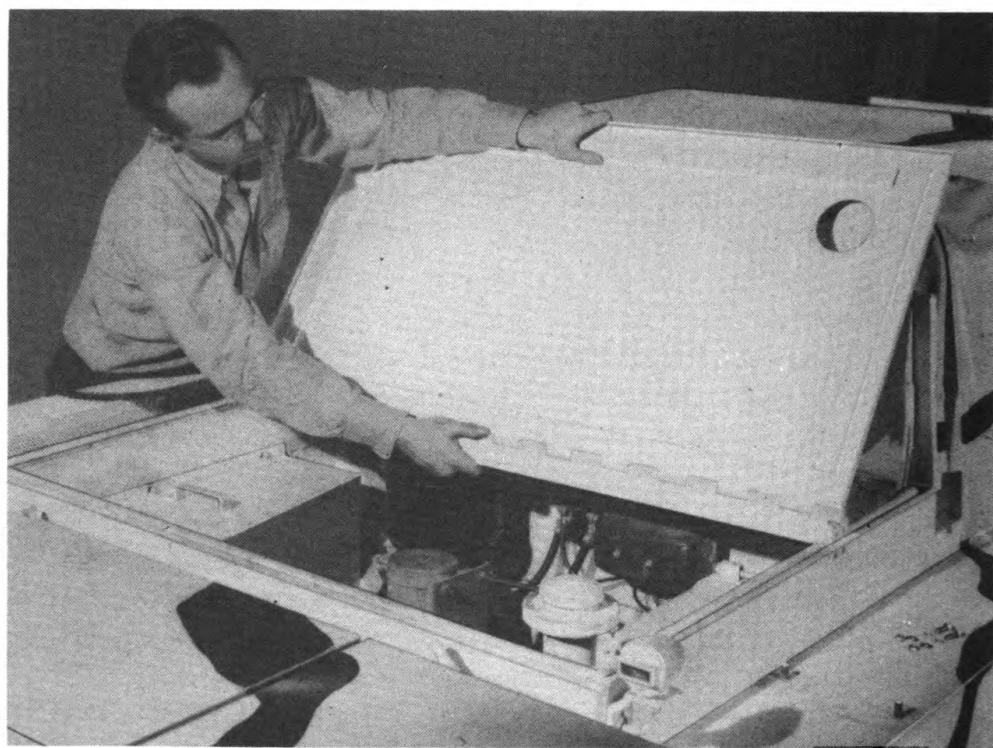
HANDLE, ratchet **WRENCH, socket, $\frac{1}{2}$ -in.**

HANDLE, speeder **WRENCH, socket, universal,**

WRENCH, open-end, $\frac{7}{16}$ -in. $\frac{1}{2}$ -in.

WRENCH, open-end, 1/2-in.

Remove the 2 lid cross bracket cap screws and lock washers at each end of the bracket (1/2-in. open-end wrench on the front 2 screws, and



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Figure 23—Engine Compartment Lid Removal

ENGINE

$\frac{1}{2}$ -in. socket wrench and ratchet handle on the rear 2 screws). Remove the bolt, nut, lock washer, and flat washer, securing each end of the lid hinge and cross brackets to an angle bracket welded on the deck coaming ($\frac{7}{16}$ -in. open-end wrench, $\frac{7}{16}$ -in. socket wrench, and ratchet handle). Remove the 9 cap screws, lock washers, and flat washers holding the cross bracket to the bulkhead ($\frac{1}{2}$ -in. universal socket wrench and speeder handle). Lift the lid with hinge and cross bracket off the vehicle.

h. Remove Air Cleaner.**SCREWDRIVER**

Loosen the air cleaner throat clamp screw (screwdriver) and remove the carburetor air cleaner assembly.

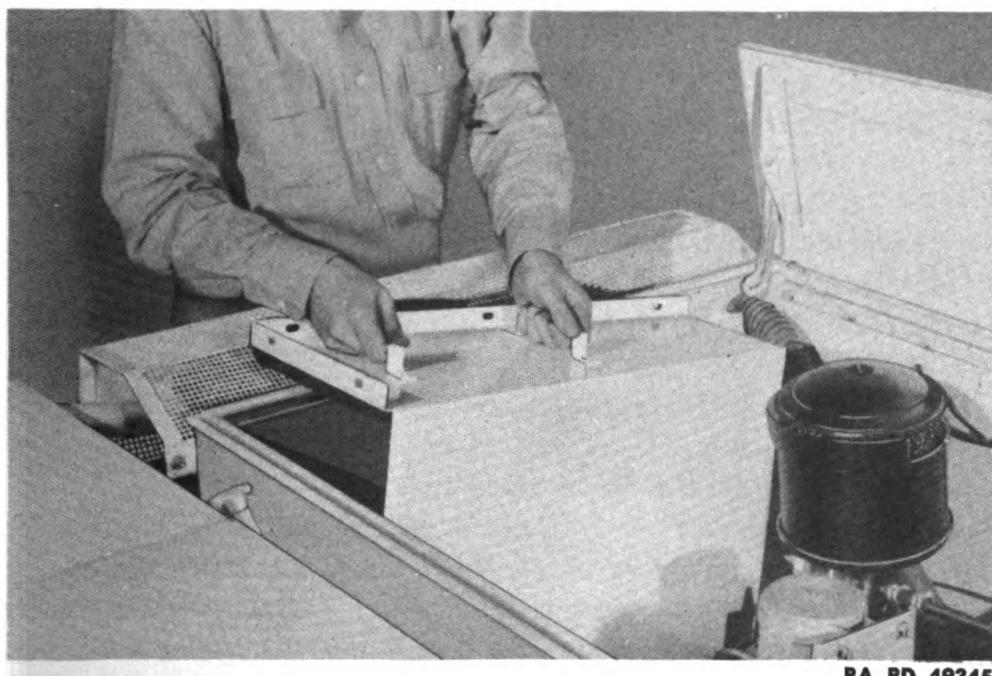
i. Remove Battery Compartment Cover and Disconnect Battery.

EXTENSION, socket	WRENCH, open-end, $\frac{7}{16}$ -in.
-------------------	---------------------------------------

HANDLE, ratchet	WRENCH, socket, $\frac{7}{16}$ -in.
-----------------	-------------------------------------

WRENCH, box, $\frac{7}{16}$ -in.	WRENCH, socket, $\frac{1}{2}$ -in.
----------------------------------	------------------------------------

Remove the 2 bolts, nuts, flat washers, and lock washers holding the battery compartment cover to the deck rear coaming ($\frac{7}{16}$ -in. open-end wrench and $\frac{7}{16}$ -in. socket wrench and ratchet handle). Remove the 7 cap screws ($\frac{1}{2}$ -in. socket wrench and ratchet handle) with flat washers and lock washers, fastening the cover to the engine compartment left quarter wall, shelf, and left deck coaming. Lift the insulated battery compartment cover upward, to the right, and out of the engine compart-



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ment (fig. 24). Disconnect and remove the battery ground strap post clamp ($\frac{3}{16}$ -in. box wrench) at the negative (—) post on the battery.

j. Drain Cooling System.

LEAD, white, basic-carbonate SCREWDRIVER
PAN, drain

Remove the cooling system drain plug (screwdriver), located on the bottom of the hull just ahead of the crankcase drain plate. After turning the radiator cap to the first stop to unseal the cooling system, open the drain valve at the radiator outlet pipe located in the lower left rear section of the engine compartment. Also, open the engine block drain valve on the right side of the engine toward the front. Loosen the battery heater hose connection clamps (screwdriver) and pull the hoses off the heater pipes. If antifreeze is in use in the cooling system, save the solution. After the cooling system has drained completely, close the engine block and radiator drain valves. Install the cooling system drain plug, after coating it with LEAD, white, basic-carbonate, for a positive seal. Tighten the plug securely.

k. Drain Engine Oil.

EXTENSION, socket SCREWDRIVER
HANDLE, ratchet WRENCH, socket, 1-in.
LEAD, white, basic-carbonate

Remove the 5 crankcase drain hull plate screws (screwdriver), gasket, and plate. Remove the oil pan drain plug (1-in. socket wrench extension, and ratchet handle). After the oil has drained, install the plug securely. Reinstall the hull plate gasket, plate, and screws, applying LEAD, white, basic-carbonate, to the parts to obtain a positive seal.

l. Remove Bulkhead with Starter Solenoid Switch, Regulator, Fire Extinguisher, Rear Demolition Bomb Case, and Demolition Timer Control Switch (fig. 25).

EXTENSION, socket WRENCH, open-end, $\frac{7}{16}$ -in.
HANDLE, ratchet WRENCH, open-end, $\frac{1}{2}$ -in.
HANDLE, speeder WRENCH, socket, $\frac{7}{16}$ -in.
SCREWDRIVER WRENCH, socket, universal,
WRENCH, open-end, $\frac{3}{8}$ -in. $\frac{7}{16}$ -in.

Remove the wires and cable at the starter solenoid switch after taking off the terminal nuts ($\frac{1}{2}$ -in. and $\frac{3}{8}$ -in. open-end wrenches). Remove the wires at the terminals on the current and voltage regulator and external filter (screwdriver). Bend down the clip on the offset at the rear of the bulkhead to unfasten the primer lines from the bulkhead. Remove the screw (screwdriver) and nut ($\frac{7}{16}$ -in. open-end wrench) which retain the oil pipe and choke tube clip to the bulkhead. Take out the 8 cap screws ($\frac{7}{16}$ -in. socket, universal, and speeder handle) holding the left and right sides of the bulkhead to the bulkhead frame. Remove

ENGINE

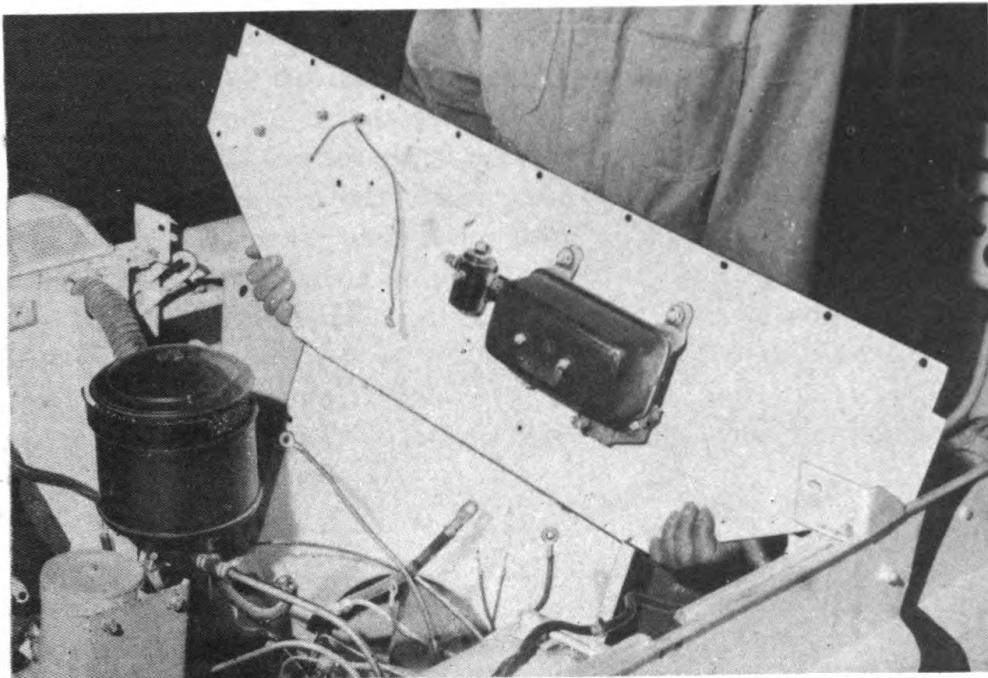


Figure 25—Bulkhead Removal

the metal screw (screwdriver) and clip to free the demolition wires on the front of the bulkhead. Turn and pull out the plug on the bottom of the demolition timer control switch box and remove the wire running through the bulkhead from the plug. Remove the nut, ($\frac{7}{16}$ -in. open-end wrench, $\frac{7}{16}$ -in. socket wrench, extension, and ratchet handle) lock-washer, flatwasher, and pull the wiring harness clip off the bolt to unfasten the harness from the rear of the bulkhead. Push the loose demolition wire through the hole in the bulkhead. Lift off the bulkhead with starter solenoid switch, regulator, fire extinguisher, and demolition equipment.

m. Remove Rear Air Duct, Fan Blades and Pulley, and Radiator with Fan Shroud.

EXTENSION, socket
HANDLE, ratchet
PAPER

SCREWDRIVER
WRENCH, socket, $\frac{1}{2}$ -in.

(1) REMOVE AIR DUCT.

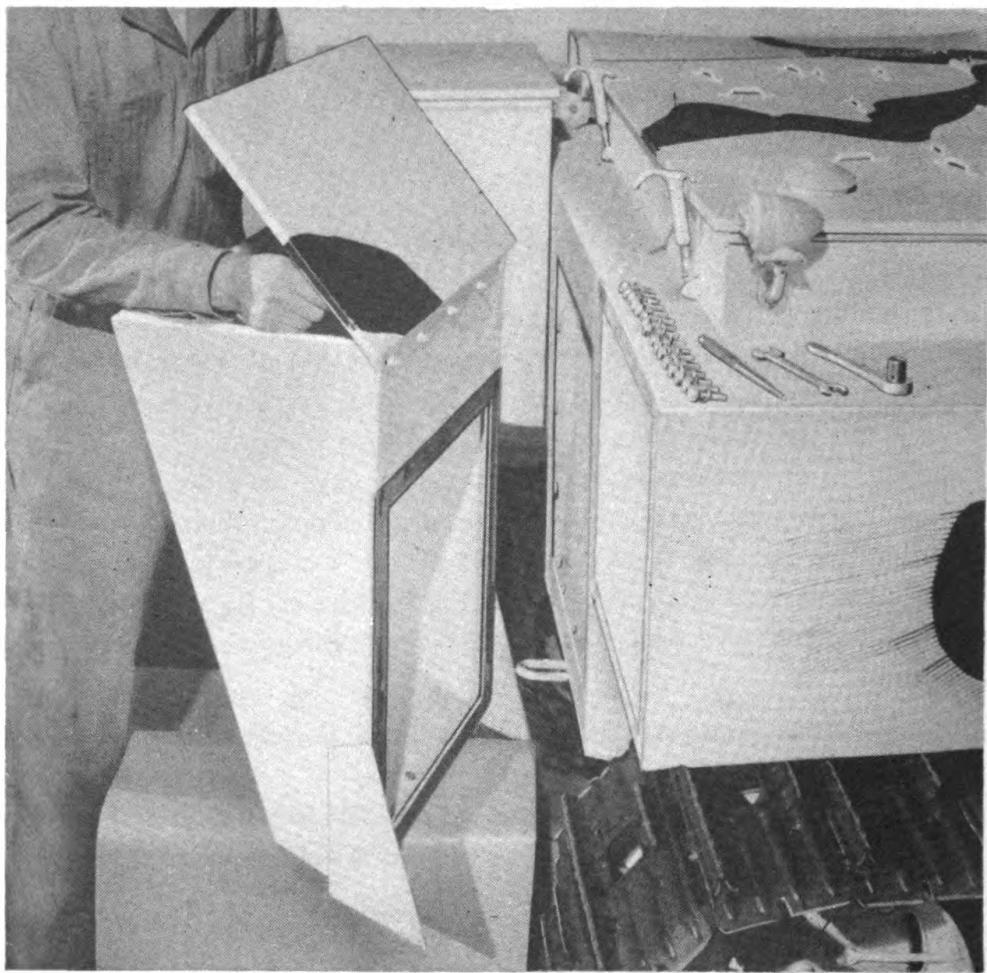
Lift off the rear air duct with lid and sponge rubber gasket after removing the 16 cap screws ($\frac{1}{2}$ -in. socket wrench, and ratchet handle), lockwashers, and flatwashers, which secure the air duct to the rear of

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the hull (fig. 26). Note that a drain plug (1/2-in. head) is located in the bottom of the air duct.

(2) REMOVE FAN BLADES AND PULLEY AND RADIATOR WITH FAN SHROUD.

Loosen fan belt tension as outlined in paragraph 74 c. Remove the 4 cap screws (1/2-in. socket wrench and ratchet handle) holding the fan blades and pulley to the water pump drive flange. Lift the blades and pulley off the belt, and out from within the fan shroud, and off the vehicle. Loosen the radiator inlet upper base clamp and upper outlet hose clamp (screwdriver) and pull off the hoses. Pull off the cylinder block drain hose at the drain valve in the radiator outlet pipe. Using a ratchet handle, extension, 1/2-inch socket wrench, and paper, within the socket, to retain the screws when loose, remove the 6 metal screws holding the left and right radiator flanges to the radiator frame of the



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Figure 26—Rear Air Duct Removal

ENGINE

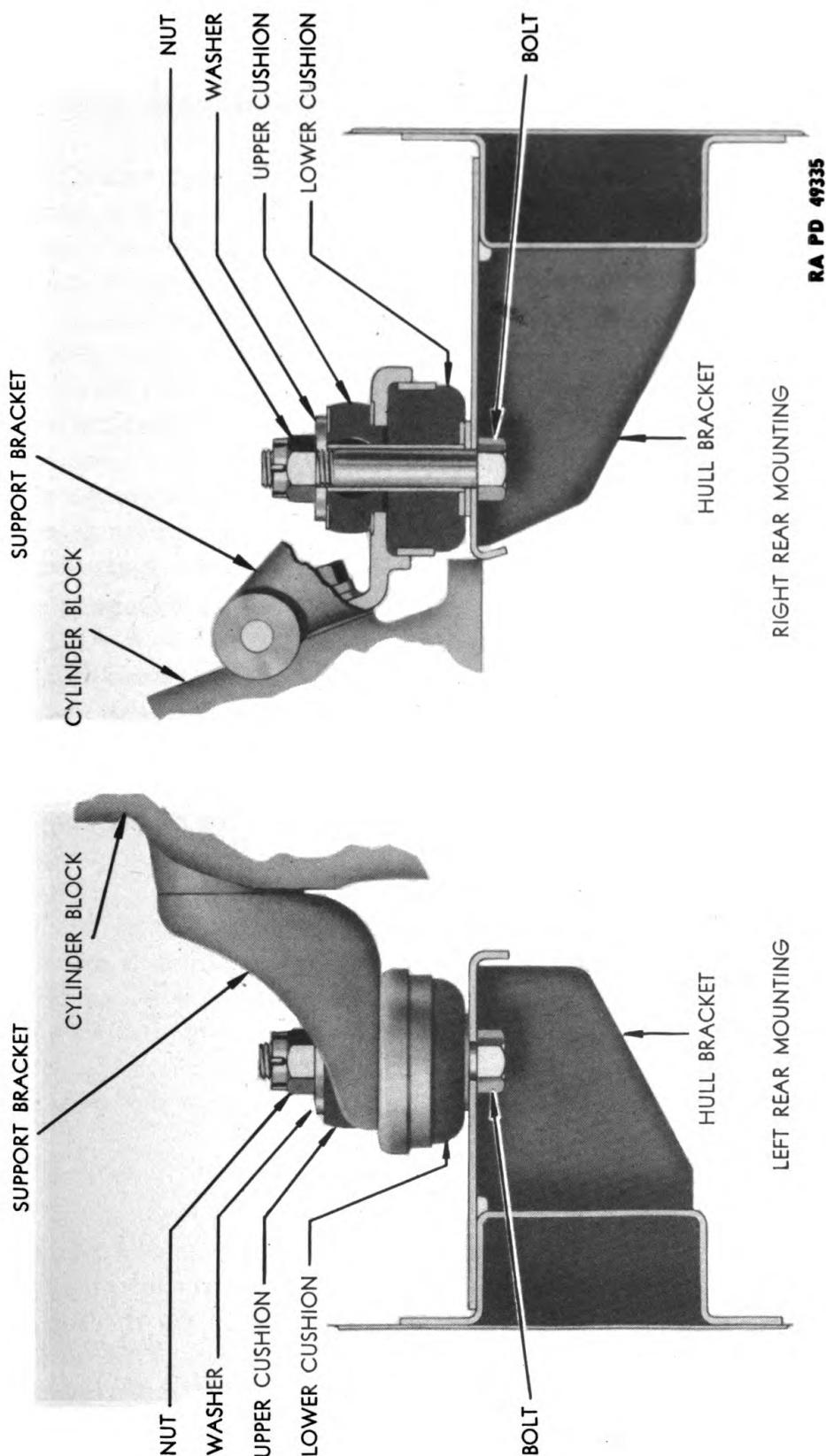


Figure 27—Engine Rear Mounting Construction

LIGHT CARGO CARRIER T-15

hull. Lift the radiator and shroud upward to clear the water pump drive flange and tilt the top of the assembly in such a manner as to permit the radiator outlet pipe and drain valve to clear.

n. Disconnect Ground Strap, Engine Rear Mountings, and Generator Wires.

EXTENSION, socket	WRENCH, open-end, $\frac{7}{16}$ -in.
HANDLE, ratchet	WRENCH, open-end, $\frac{1}{2}$ -in.
PLIERS	WRENCH, open-end, $\frac{3}{4}$ -in.
SCREWDRIVER	WRENCH, socket, $\frac{1}{2}$ -in.
WRENCH, box, $\frac{3}{4}$ -in.	

Disconnect the engine ground strap from the hull ($\frac{1}{2}$ -in. open-end wrench, $\frac{1}{2}$ -in. socket, extension, and ratchet handle) by removing the bolt, nut, 2 flat washers, and lock washer. Take out the cotter pins (pliers) and remove the 2 castellated nuts ($\frac{3}{4}$ -in. box wrench and $\frac{3}{4}$ -in. open-end wrench) and flat washers at the engine rear mounting brackets (fig. 27). Disconnect the wires at the generator terminals ($\frac{1}{2}$ -in. open-end wrench, screwdriver, and $\frac{7}{16}$ -in. open-end wrench).

o. Disconnect Engine Heat Indicator, Oil Pressure Gage, Primer Pipes, Fuel Tank Line, and Ignition Coil.

WRENCH, open-end, $\frac{9}{32}$ -in.	WRENCH, open-end, $\frac{7}{16}$ -in.
WRENCH, open-end, $\frac{3}{8}$ -in.	WRENCH, open-end, $\frac{9}{16}$ -in.
WRENCH, open-end, $\frac{1}{2}$ -in.	WRENCH, open-end, $\frac{5}{8}$ -in.

Uncouple the heat indicator element at the right front side of the cylinder head ($\frac{5}{8}$ -in. open-end wrench). Disconnect the oil pressure gage pipe at its flexible coupling ($\frac{7}{16}$ -in. and $\frac{9}{16}$ -in. open-end wrenches) above the front of the engine. Disconnect the primer suction pipe at its flexible coupling ($\frac{3}{8}$ -in. and $\frac{1}{2}$ -in. open-end wrenches) above the No. 6 (front end) cylinder. Disconnect the primer pipe running to the intake manifold at the front tee connection ($\frac{3}{8}$ -in. open-end wrench). Disconnect the gasoline tank pipe at the lower end of the flexible coupling, using a $\frac{9}{32}$ -inch open-end wrench on the coupling and a $\frac{1}{2}$ -inch open-end wrench on the union nut. Disconnect the harness wire at the ignition coil ($\frac{3}{8}$ -in. open-end wrench).

p. Disconnect Choke and Throttle Controls.

SCREWDRIVER.

Remove the screw (screwdriver) holding the throttle cable tube clip to the cylinder head clip. Disconnect the carburetor throttle valve control by unhooking the pull back spring and the cable to the throttle valve operating arm. Disconnect the carburetor choke control after loosening the choke-valve-lever-swivel-clamp-screw and cable-clamp-screw at the fastening bracket (screwdriver).

q. Uncouple Exhaust Pipe.

SCREWDRIVER

WRENCH, open-end, $\frac{9}{16}$ in. (2)

ENGINE

Remove the bolt and nut (two $\frac{9}{16}$ -in. open-end wrenches) which secure the exhaust pipe clamp to the support bracket at the left front of the cylinder head. Spread the clamp (screwdriver) and pull the section with the flexible end upward and off the lower section of the exhaust pipe.

r. Disconnect Engine Front Support.

EXTENSION, socket **WRENCH, socket, $\frac{9}{16}$ -in.**
HANDLE, ratchet

Remove the 2 cap screws ($\frac{9}{16}$ -in. socket, extension, and ratchet handle) with lock washers which hold the engine front support (transmission support) to the hull frame.

s. Install Lifting Eyes.

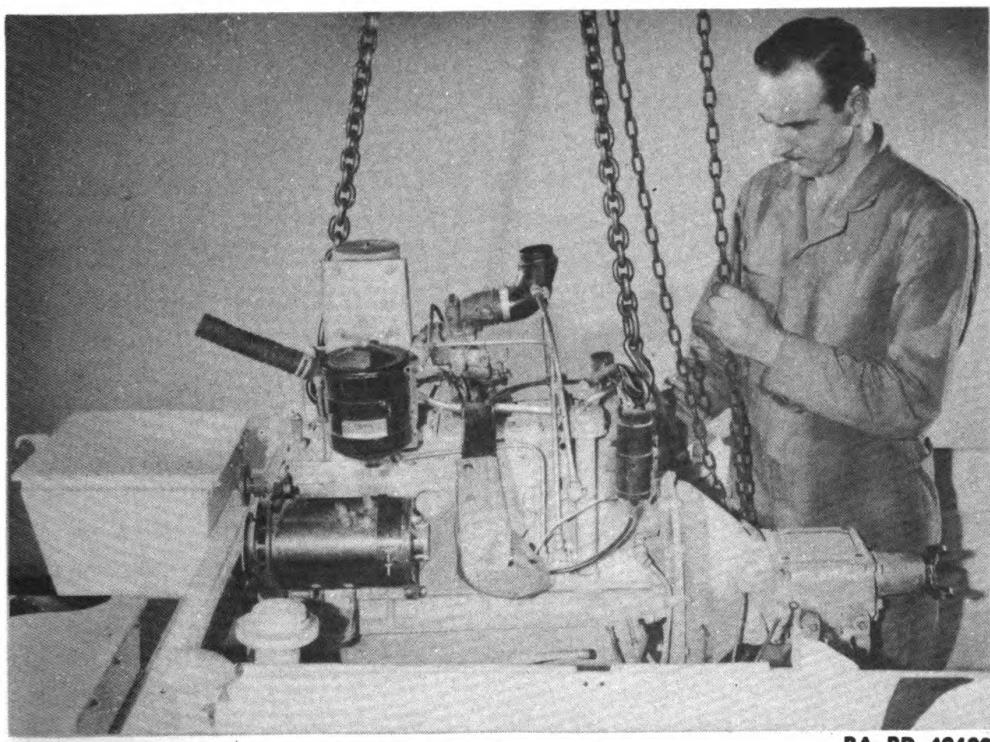
BOLT, eye, engine lifting HKM **HANDLE, ratchet**
J53 (2) **WRENCH, socket, $1\frac{1}{16}$ -in.**
EXTENSION, socket

Remove cylinder head screws No. 9 and No. 10 (see cylinder head screw tightening chart (fig. 33) with a $1\frac{1}{16}$ -inch socket wrench, extension, and ratchet handle. Install engine lifting eye bolts (HKM-J53) in place of the 2 cylinder head screws removed.

t. Remove Engine (including Clutch and Transmission).

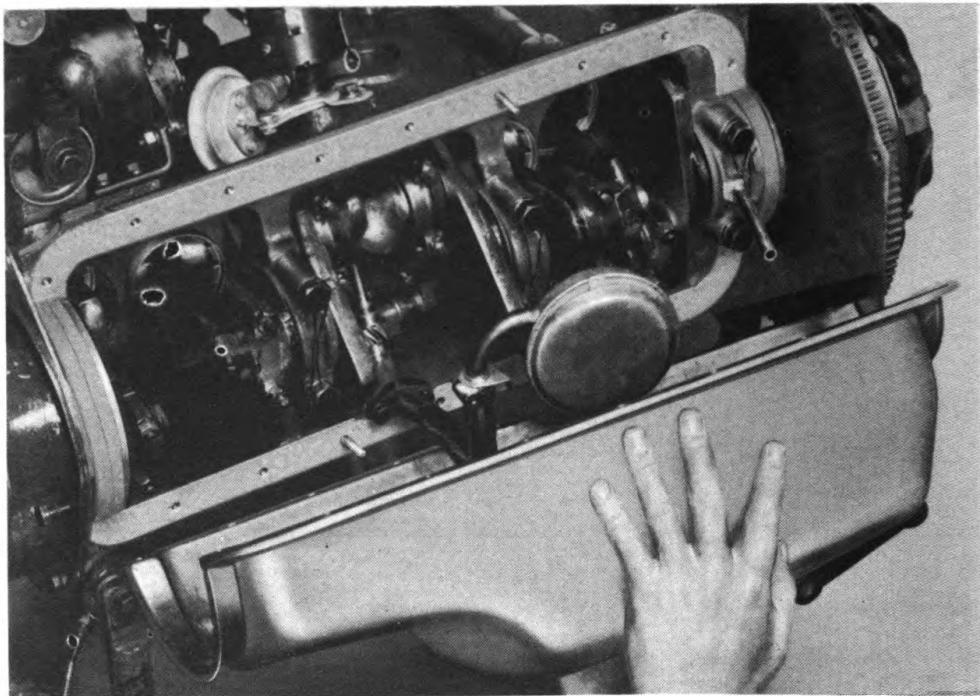
CHAIN, lifting **HOIST**

Attach chain to the lifting eye bolts. Fasten hoist to the chain and, after checking to make sure all wires, cables, lines, and connections to the hull or other units have been disconnected, slowly lift the weight of the engine off the engine support brackets and hull frame (fig. 28). Move

**Figure 28—Engine Removal**

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RA PD 49329

Figure 29—Engine Oil Pan Removal

the engine forward slightly, then up and out of the compartment, guiding it carefully to avoid catching uncoupled pipes, wires, and controls.

56. LUBRICATION.

a. **Lubrication System.** The full pressure engine lubrication system is composed of a gear pump connected with a floating oil intake screen, galleries drilled into the cylinder block, an oil pressure relief valve, an oil filter, and a diluter (fig. 18). The oil pump is located on the left side of the cylinder block. The pump cannot be removed as a unit, the various parts being assembled onto the cylinder block. Helical gears are used, and the pump is driven by the camshaft through helical gearing.

b. Equipment.

CEMENT, gasket

EXTENSION, socket

HANDLE, ratchet

HANDLE, speeder

KNIFE, putty

SCREWDRIVER

WRENCH, open-end, $\frac{3}{8}$ -in.

WRENCH, open-end, $\frac{7}{16}$ -in.

WRENCH, open-end, $\frac{1}{2}$ -in.

WRENCH, open-end, $\frac{9}{16}$ -in.

WRENCH, open-end, $\frac{5}{8}$ -in.

WRENCH, open-end, $\frac{3}{4}$ -in.

WRENCH, socket, $\frac{1}{2}$ -in.

WRENCH, socket, $\frac{9}{16}$ -in.

Original from

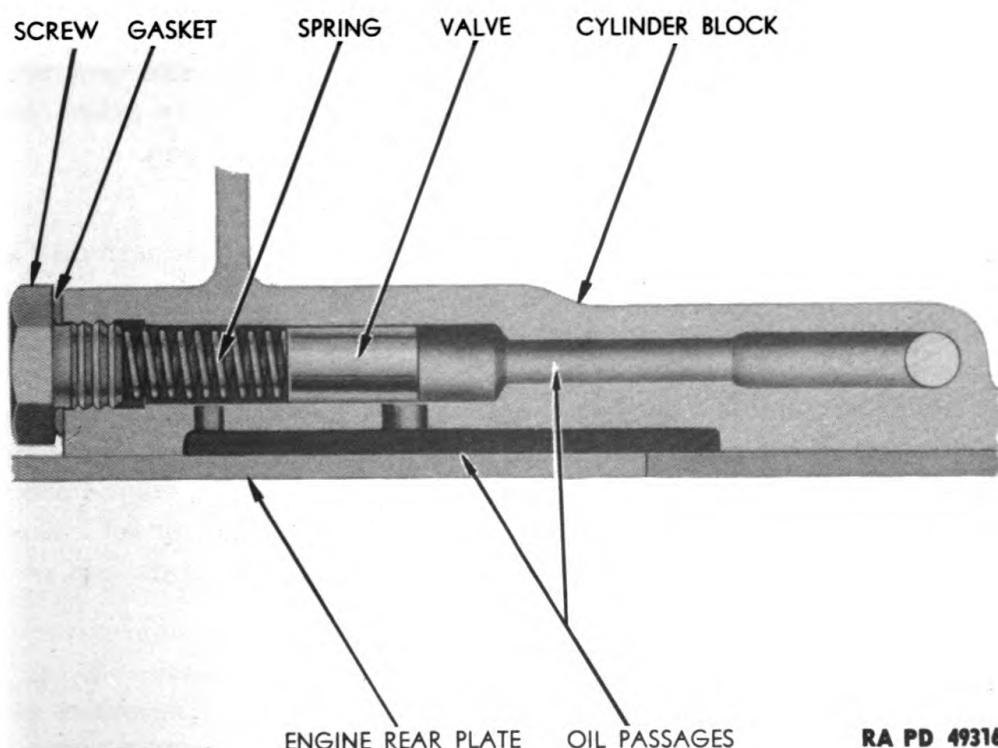
ENGINE

c. Remove Oil Pan.

- (1) Remove the engine as directed in paragraph 55.
- (2) Remove the engine oil level gage with cap.
- (3) Using a $\frac{1}{16}$ -inch socket wrench, ratchet handle, and a $\frac{1}{16}$ -inch open-end wrench, remove the 3 bolts, nuts, and lock washers attaching the starting motor to the engine front plate and clutch housing (fig. 18). Remove the starter from the engine.
- (4) Remove the 18 cap screws and lock washers which secure the oil pan to the engine crankcase ($\frac{1}{2}$ -in. socket and speeder handle). Bump the oil pan to break it loose from the gaskets (fig. 29).
- (5) Scrape off the gasket contacting surfaces, using a putty knife. Remove the oil pan rear cork seal from the oil pan filler block and the oil pan front gasket from the front main bearing cap.

d. Installation of Oil Pan.

- (1) Equipment as listed in paragraph 56 b.
- (2) Reverse the removal procedure to install the oil pan (fig. 29). Clean the oil pan thoroughly and use new gaskets throughout. The gaskets must be coated with gasket cement to avoid possible leakage. Tighten the pan to crankcase cap screws uniformly to assure a positive seal. After refilling the engine to the proper level with the correct grade



RA PD 49316

Figure 30—Oil Pressure Relief Valve Construction

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of engine oil (sec. V), inspect for leakage. Install the engine as directed in paragraph 66.

e. Engine Oil Strainer. The oil pump intake pipe carries a floating screen which strains clean oil taken from the top surface of the oil in the oil pan before circulation through the system. Stops on the strainer elbow and pipe limit the travel of the strainer. To remove the strainer (engine out of hull) it is necessary to remove the oil pan (par. 56 e) and take out the cotter pin (pliers) which holds the strainer on the intake pipe.

f. Oil Galleries. All of the oil passages are drilled in the cylinder block itself. The engine must be removed and completely disassembled in order to blow out the oil galleries.

g. Oil Pressure Relief Valve. This plunger type valve is located in the cylinder block just below the left rear engine support bracket. The valve consists of a drilled passage in which a spring loaded plunger operates against oil pressure in the lubrication system. The valve is non-adjustable. After removing the nearest timing gear cover bolt, nut, and lock (two $\frac{1}{2}$ -in. open-end wrenches) remove the valve plug ($\frac{7}{8}$ -in. socket wrench, extension, and ratchet handle) and gasket to make the spring and plunger accessible (fig. 30). The timing gears are lubricated with oil by-passed by the relief valve as well as from oil metered through a drilled hole in the valve.

h. Engine Oil Filter Assembly. The military standard, replaceable cartridge type engine oil filter is mounted with bands to a vertical bracket fastened on the right rear portion of the cylinder head. The unit filters impurities out of the oil and is connected in the system by a line from the main gallery and a return to the oil supply in the oil pan.

(1) CARTRIDGE INSTALLATION.

To install a new cartridge as directed in the "Lubrication" section (V), remove the cover plug ($\frac{3}{4}$ -in. open-end wrench), cover with spring, and gasket. Remove the drain plug ($\frac{1}{16}$ -in. open-end wrench) at the bottom of the filter. Allow the sludge to drain, reinstall the drain plug, and lift out the filter element (fig. 31). Install a new element and gasket, then the cover with spring and the cover plug. Tighten the cover plug with a $\frac{3}{4}$ -inch open-end wrench (7-inch length) until tight. The engine should be operated and the filter and surrounding area checked for oil leakage. Recheck for leaks at this point and the tightness of the drain and cover plugs after a day's run.

(2) OIL FILTER ASSEMBLY REMOVAL.

To remove the engine oil filter assembly, disconnect the outlet pipe at the filter coupling ($\frac{1}{16}$ -in. open-end wrench). Disconnect the inlet pipe ($\frac{3}{8}$ -in. open-end wrench) from the filter. Remove the 4 filter mounting bolts, nuts, flat washers, and lock washers ($\frac{1}{2}$ -in. open-end wrench

ENGINE



RA PD 49351

Figure 31—Oil Filter Cartridge Removal

and $\frac{1}{2}$ -in. socket wrench extension, and ratchet handle). Hold the filter unit with one hand while removing the last bolt.

i. **Diluter Assembly.** Because most of the operation of this vehicle is expected to be where low temperatures prevail, there would normally be considerable difficulty in starting due to high internal resistance resulting from congealed engine oil—especially after a halt of several hours in subzero weather. To combat this hazard a diluter has been provided which, if used properly, will eliminate difficulty in starting due to congealed oil. The diluter system consists of a small fuel reservoir of 1-quart capacity; the pipe system from the fuel pump to the reservoir; and piping from the reservoir to the oil pan. Since the diluter reservoir depends on the fuel pump for filling and the diluent is to be mixed with the engine oil, the diluter must be operated before stopping the engine, when a halt of several hours duration or longer is expected, and temperature is below —20 degrees F (see engine oil dilution chart, par. 56 j shown below).

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The diluter 3-way control valve is so arranged that when the handle is vertical, both lines are closed and the diluter is neutral (fig. 18). When the handle is turned counterclockwise (lower end toward the rear), the inlet is opened and gas will flow into the reservoir from the fuel pump. When the handle is turned clockwise (bottom of handle toward the front), the inlet is closed and the outlet is opened to permit the gasoline to flow into the oil pan. The diluter is operated *before stopping the engine* as follows:

(1) Move the 3-way valve (below diluter) counterclockwise to the full open inlet position. Gasoline will flow into the reservoir from the fuel pump.

(2) When the first offset mark on the diluter float indicator stem has risen through the cover, $\frac{1}{2}$ pint of gasoline will have been pumped into the reservoir. When the fourth mark on the stem has been exposed, the reservoir is full (1-quart capacity). Turn the valve clockwise to the mid-point (valve handle vertical) to stop the inflow of gasoline, otherwise the reservoir will overflow.

(3) To drain the reservoir, move the valve clockwise to the full open outlet position. This will allow the gasoline in the reservoir to flow into the oil pan. When the stem of the indicator has receded into the cover all the way, the reservoir is empty and the valve handle can be turned back to the vertical position (inlet and outlet closed).

(4) Run the engine at a fast idle speed for 5 minutes after operating the diluter in order to thoroughly mix the engine oil with the gasoline.

(5) The diluter is inoperative when the valve handle is in a vertical position.

(6) When it is desired to inject more gasoline into the oil pan than the reservoir will hold, 1 quart should be injected as outlined previously and the procedure repeated as required to provide dilution exactly in accordance with dilution chart.

j. Engine Oil Dilution Chart.

Temperature	Percentage of Dilution	Amount of Diluent
0 F	None	None
-10 F	None	None
-20 F	10 percent	$\frac{1}{2}$ qt
-30 F	20 percent	1 qt
-40 F	30 percent	$1\frac{1}{2}$ qt

NOTE: The data given in the chart is predicated on the use of OIL, engine, SAE 10, which is in accordance with the oil recommendations for the temperatures shown. It must be borne in mind by the driver that when a 30 percent dilution of the engine oil has been provided, 4 hours of engine operation will be required to "crack off" (dissipate) the gasoline diluent. For example: if the engine was last stopped when the

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temperature was —40 degrees F, the dilution was 30 percent ($1\frac{1}{2}$ qt), and after starting it was operated for only 2 hours, half ($\frac{3}{4}$ qt) of the diluent would still remain in the oil. On again diluting at the end of the 2-hour period, only $\frac{3}{4}$ quart of fuel might be injected into the oil pan in order to preserve the proper percentage of dilution for the temperature of —40 degrees F. Failure to re-dilute only to the extent mentioned would result in making the next start with 45 percent dilution instead of the 30 percent dilution as called for on the chart. If such a practice were repeated time after time, engine lubrication would suffer and actual damage would very likely occur to engine parts. *Keep a record of operating time while diluted oil is in use and calculate succeeding dilutions to give the starting protection required.* When using gasoline for a diluent, the heat generated by the operating engine will cause the diluent to vaporize and be dissipated through the exhaust system. In this way, the lubricating quality of the engine oil will be fully restored after several hours of running. Even though this is a distinct advantage to the engine lubrication system, it will be absolutely necessary that the oil be diluted at the end of each operating period in temperatures requiring dilution. A danger of eventual over-dilution may arise from the use of gasoline as a diluent if the engine is not operated for a sufficient length of time to vaporize all of the gasoline in dilution. Refer to the example of such a situation as discussed previously. The diluter requires no special attention; however, if it becomes necessary to remove the diluter for repairs or replacement, disconnect the inlet and outlet pipe at the valve ($\frac{5}{8}$ -in. open-end wrench) remove the 4 bolts, ($\frac{1}{2}$ -in. open-end wrench, $\frac{1}{2}$ -in. socket wrench, extension, and ratchet handle) flat washers, lock washers and nuts that secure the reservoir straps to the bracket. If necessary the straps can be removed from the reservoir (screwdriver and $\frac{7}{16}$ -in. open-end wrench).

57. CYLINDER HEAD AND MANIFOLD.

a. **Equipment.** Tools as listed in paragraph 55 a if engine is to be removed.

b. Removal and Disassembly.

(1) Remove the engine with clutch and transmission as outlined in paragraph 55 if operations involving removal of the manifold or adjustment of the valves are required.

(2) Disconnect all spark plug wires as outlined in paragraph 59.

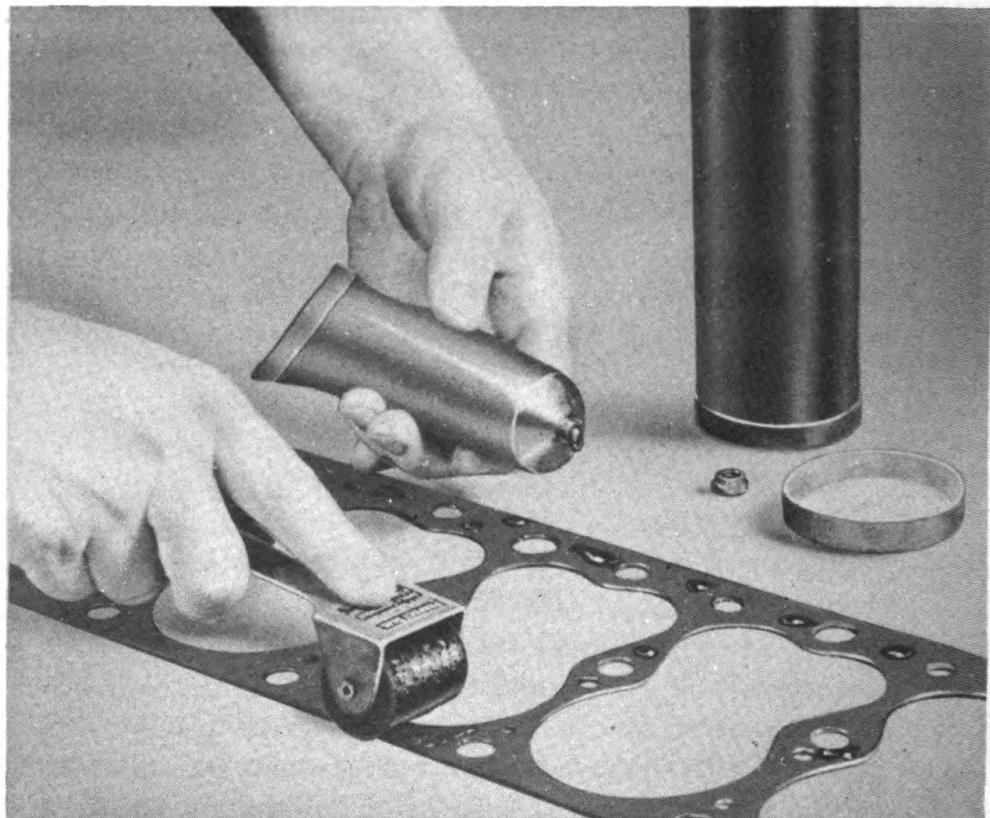
(3) If not disconnected previously, loosen the upper radiator hose top clamp (screwdriver) and pull off the hose. Remove the 2 cylinder head cap screws ($1\frac{1}{16}$ -in. socket wrench, extension, and ratchet handle) holding the cylinder head water outlet elbow to the head and remove the water outlet elbow, gasket, thermostat, and sleeve. Scrape off the gasket and apply a new gasket to the outlet flange using **GREASE**, Original from

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general purpose, to hold the gasket in position while installing. Also, apply a new gasket to the shoulder within the water outlet elbow.

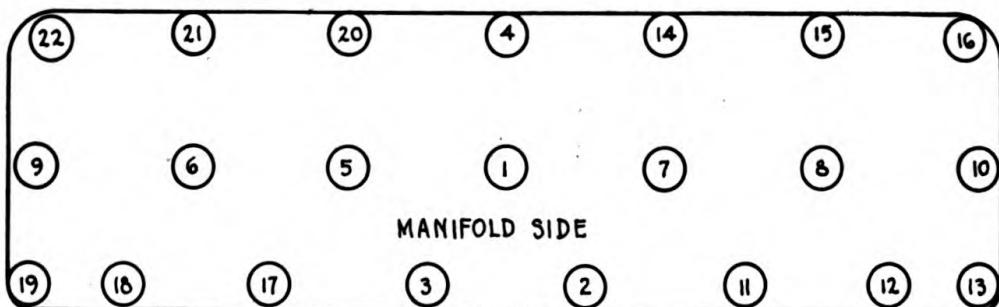
(4) Remove the remaining cylinder head screws ($1\frac{1}{16}$ -in. socket wrench, extension, and ratchet handle).

(5) Exercise care in lifting the cylinder head and gasket to avoid possible damage to the valves. Scrape off all carbon formation on the head.



RA PD 58276

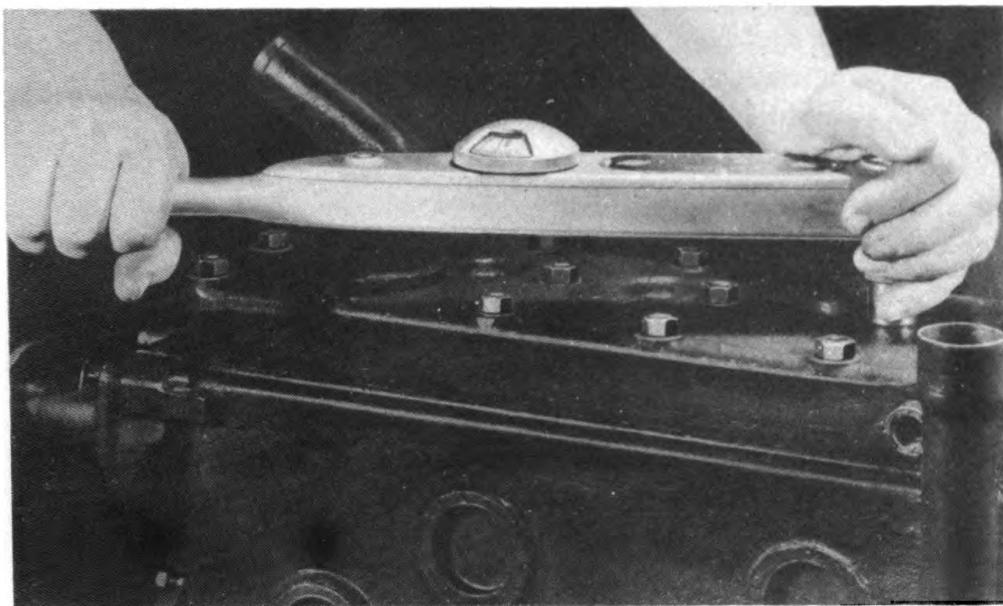
Figure 32—Applying Cement to Cylinder Head Gasket



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Figure 33—Cylinder Head Cap Screw Tightening Chart

ENGINE



RA PD 49328

Figure 34—Tightening Cylinder Head Screws with Torque Wrench AMM-1

(6) Disconnect the primer inlet line at the fuel pump ($\frac{3}{8}$ -in. open-end wrench), disconnect the main fuel line at the fuel pump elbow fitting ($\frac{1}{2}$ -in. open-end wrench), disconnect the breather pipe at the manifold and at the front valve cover fitting ($\frac{5}{8}$ -in. open-end wrench), and disconnect and remove the fuel line from the fuel pump to carburetor bowl ($\frac{7}{16}$ -in. open-end wrench).

(7) Remove the 6 manifold stud nuts ($\frac{9}{16}$ -in. box wrench) and retainers and lift off the manifold assembly with gasket. Check the manifold heat control valve as outlined in paragraph 61 a (1) and free the shaft if necessary.

c. Assembly and Installation.

(1) Tools as listed in paragraph 55 a.

WRENCH, tension, AMM-1

(2) Using a new cylinder head gasket, apply gasket cement on the lower face of the cylinder head and the bottom face of the gasket (fig. 32). Reverse the removal procedure to install the parts removed. Make sure that nothing has fallen on top of the pistons before installing the cylinder head. LEAD, white, basic-carbonate, must be applied to the threads of all cylinder head screws before installation. All cylinder head screws should be given a final tightening in the proper sequence, as given on the chart (fig. 33), with tension wrench AMM-1 to a tension of 600 to 650 inch pounds (fig. 34).

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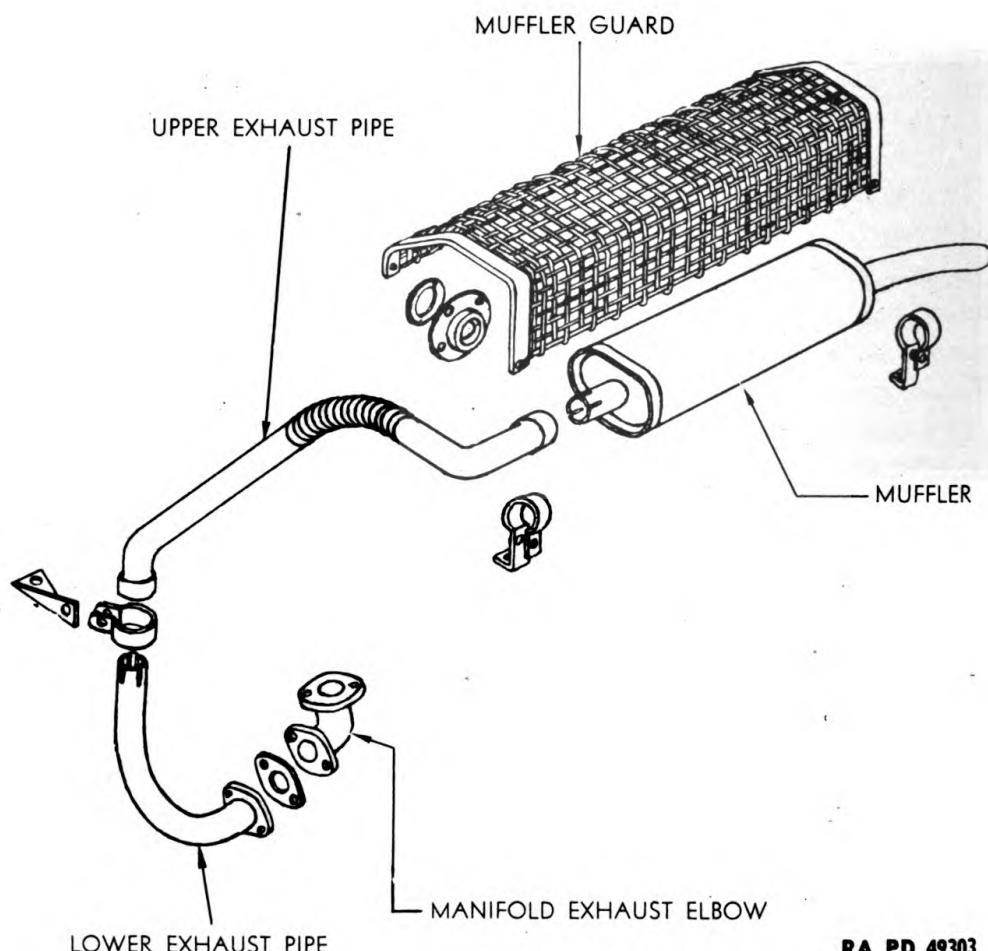
58. EXHAUST SYSTEM.

a. **Description.** The engine exhaust system consists of a muffler with tail pipe and a two-section exhaust pipe (fig. 35). The muffler is mounted on the left deck and held in position by two clamp brackets. One of the exhaust pipe sections consists of two solid pipe ends and a flexible pipe. The other section is solid and flanged at one end for attachment to the manifold elbow.

b. Muffler and Exhaust Pipes Removal.

EXTENSION, socket	WRENCH, open-end, $\frac{1}{16}$ -in.
HANDLE, ratchet	WRENCH, open-end, $\frac{1}{2}$ -in.
WRENCH, box, $\frac{1}{16}$ -in.	WRENCH, open-end, $\frac{9}{16}$ -in.
WRENCH, box, $\frac{9}{16}$ -in.	WRENCH, socket, $\frac{1}{2}$ -in.
WRENCH, open-end, $\frac{3}{8}$ -in.	

(1) Remove the 4 bolts, nuts, lock washers, and flat washers, ($\frac{1}{16}$ -in. box wrench and $\frac{7}{16}$ -in. open-end wrench) that secure the muffler guard in position.



RA PD 49303

Figure 35—Exhaust System Parts

ENGINE

(2) Remove the exhaust muffler rear clamp to deck bolt and lock washer (1/2-in. open-end wrench). Loosen the bolt, nut, and lock washer clamping the bracket to the muffler (1/2-in. socket wrench, extension, ratchet handle, and 1/2-in. open-end wrench). Remove the clamp from the tail pipe.

(3) Remove the exhaust muffler front clamp bolt and lock washer (1/2-in. open-end wrench). Loosen the bolt, nut, and lock washer clamping the upper exhaust pipe section to the muffler front pipe (1/2-in. socket wrench, extension, ratchet handle, and 1/2-in. open-end wrench). Remove the muffler.

(4) Remove the 4 metal screws (3/8-in. open-end wrench) that secure the exhaust pipe to hull gasket retainer to the deck coaming.

(5) Loosen the clamp bolt, nut, and lock washer (9/16-in. box wrench and 9/16-in. open-end wrench) clamping together the upper and lower sections of the exhaust pipe. Remove the upper section of the exhaust pipe.

(6) Remove the 2 bolts, brass nuts, and gasket (two 9/16-in. open-end wrenches) attaching the lower exhaust pipe flange to the manifold elbow. Remove the lower exhaust pipe.

(7) Remove the 2 brass nuts and gaskets (9/16-in. box wrench) attaching the exhaust pipe elbow to the manifold. Remove the elbow.

c. Muffler and Exhaust Pipes Installation.

(1) Equipment as listed under paragraph 58 b.

(2) Reverse the removal steps, use new gaskets at the lower exhaust pipe flange to elbow flange, the elbow to manifold flange and the exhaust pipe to hull gasket retainer.

59. SPARK PLUGS.

a. Removal.

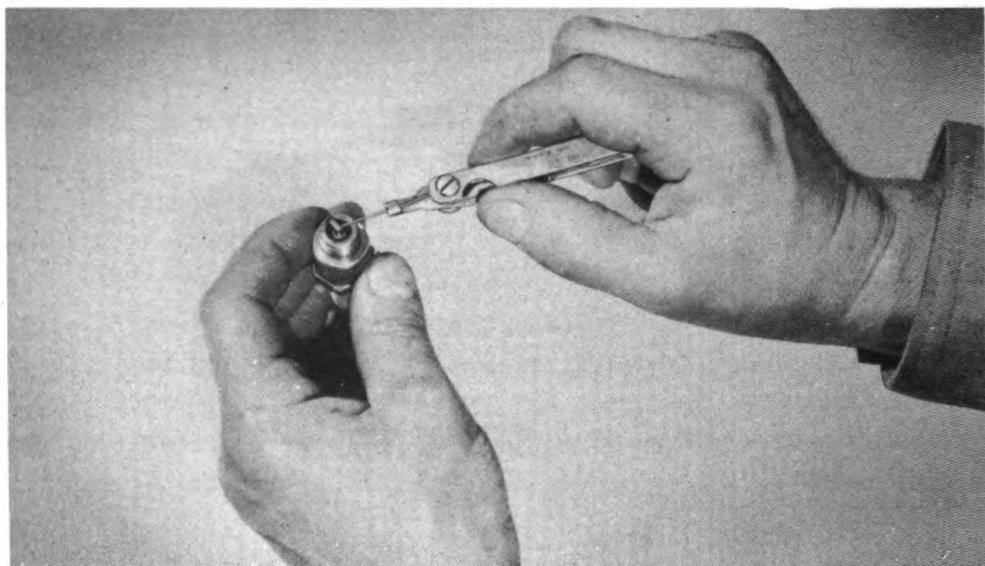
HANDLE, spark plug wrench WRENCH, spark plug, 1 3/16-in.

(1) To remove a spark plug, raise the engine compartment lid, disconnect the secondary cable by pulling the L-shaped suppressor terminal off the top of the spark plug. After removing the rubber umbrella shield, use the spark plug socket wrench (1 3/16-in.) and handle from the vehicle tool kit to remove the plug and gasket. Prior to the removal of the plug it is advisable to blow all dirt and grit out of the spark plug recess and from the area surrounding the recess; otherwise, when the plug is removed there will be nothing to prevent foreign matter from entering the cylinder to cause eventual damage to the cylinder, piston, and valves.

b. Adjustment.

GAGE, spark plug gap, SN-308W

(1) The spark plugs should be cleaned at 3,000-mile intervals by sand blasting. (Do not clean the porcelain with anything that will



RA PD 49364

Figure 36—Checking Spark Plug Gap Gage SN-308W

scratch it.) If any adjustment is necessary to provide the proper gap (0.025-in.), bend the grounded (outer) electrode. Use wire-type gage SN-308W to measure the gap.

c. Installation.

(1) Tools as listed in paragraph 59 a and b.

(2) When new spark plugs are installed, check the gap between the electrodes (spark plug gap gage SN-308W) and adjust them to 0.025-inch if necessary. Make sure the new gasket is on the threaded end of the plug with the seam in the gasket toward the cylinder head. Make sure there are no particles of dirt on the machined surface of the cylinder head at the bottom of the spark plug recess and, using the spark plug socket wrench, turn the plug in until the gasket can be felt to compress. (Avoid over-tightening of spark plugs; they should be tight enough to make a good seal and no more.) Install the rubber shield and connect the suppressor terminal, making sure that it is pushed down until a click indicating a positive connection can be heard.

60. IGNITION SYSTEM.

a. Distributor.

(1) **MAINTENANCE.** Distributor maintenance involves periodic lubrication; checking the contact points along with the rotor and cap; and correct setting for proper ignition timing (fig. 37). Refer to paragraph 60 c.

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(2) REMOVAL OF DISTRIBUTOR.

CRANK, engine hand

WRENCH, open-end, $\frac{3}{8}$ -in.

HANDLE, flex

WRENCH, open-end, $\frac{1}{2}$ -in.

SCREWDRIVER

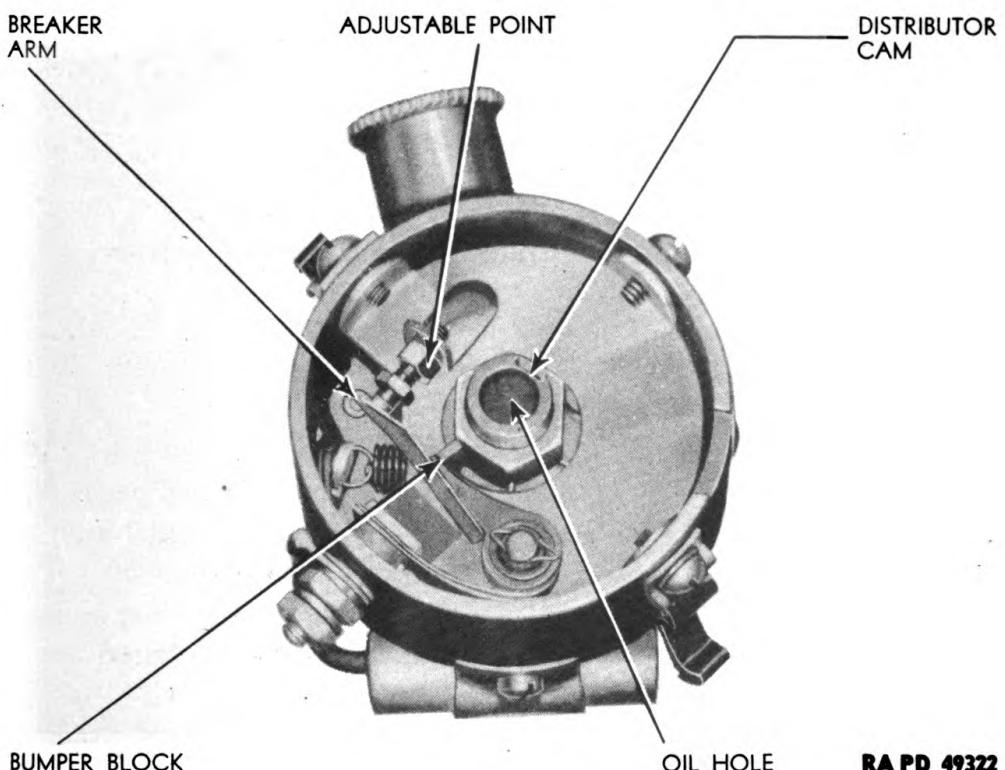
WRENCH, socket, $1\frac{1}{16}$ -in.

(a) Remove the engine with clutch and transmission as directed in paragraph 55.

(b) Push the distributor canvas cover up to expose the distributor cap and unlatch the distributor cap retainer clips. Move the cap, still attached to the secondary cables, to one side and out of the way.

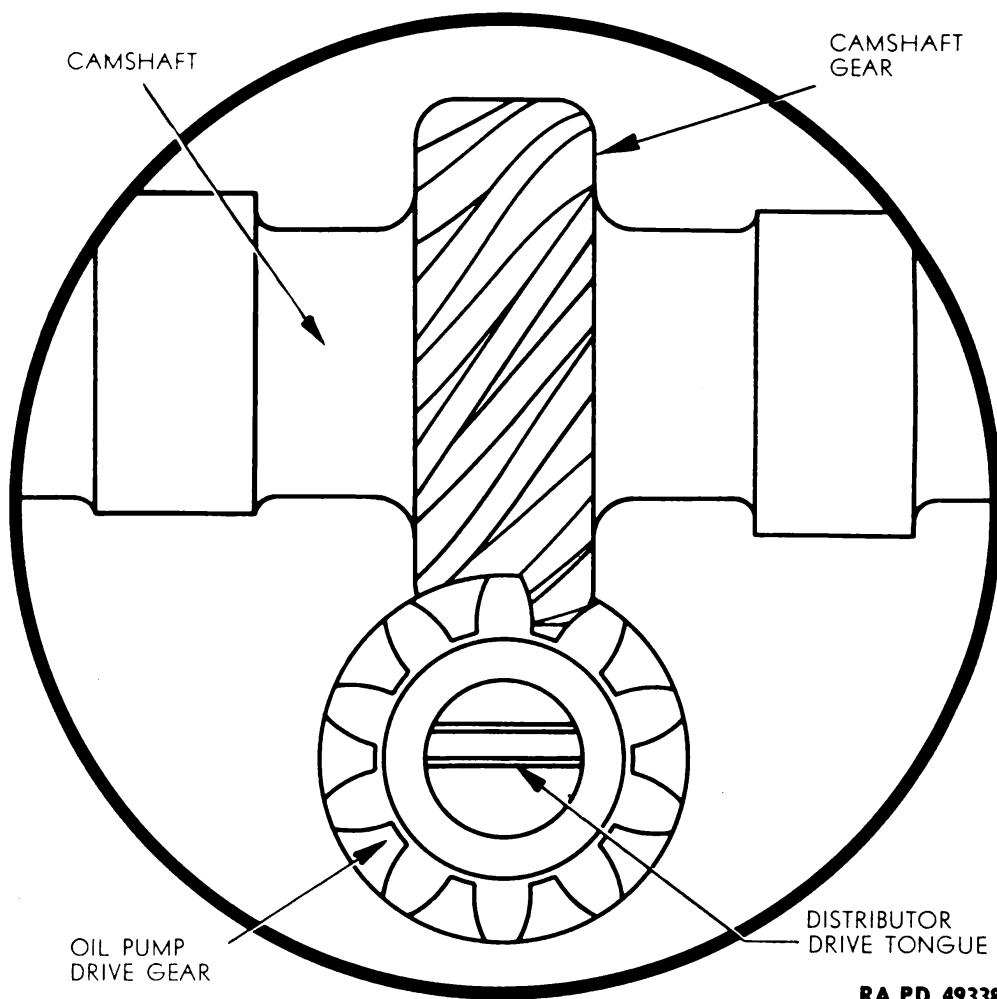
(c) Crank the engine with the hand crank until the rotor is in the No. 1 (rear cylinder) firing position and the timing mark on the rear face of the flywheel is directly under the pointer on the engine front plate (right side).

(d) Remove the primary wire nut ($\frac{3}{8}$ -in. open-end wrench) and lock washer, disconnect the primary wire, loosen the distributor clamp screw (screwdriver and $\frac{1}{2}$ -in. open-end wrench), and pull the distributor assembly out of the engine.



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RA PD 49338

Figure 38—Distributor Shaft Engagement Position

(3) DISTRIBUTOR INSTALLATION.

LIGHT, ignition timing, WEI-

892

SCREWDRIVER

WRENCH, open-end, $\frac{3}{8}$ -in.

WRENCH, open-end, $\frac{7}{16}$ -in.

WRENCH, open-end, $\frac{1}{2}$ -in.

(a) Turn the rotor to the No. 1 (rear cylinder) firing position and install the distributor, oscillating the rotor until the distributor shaft driving tongue engages with the oil pump drive shaft (fig. 38). Loosen the octane selector screw ($\frac{7}{16}$ -in. open-end wrench) and move the pointer until it is alined with the punch mark on the machined distributor support boss. Tighten the selector screw.

(b) With the engine flywheel mark (UDC 1-6) exactly under the pointer on the engine front plate, turn the distributor body right or left until the points are just in the act of separating. Tighten the clamp screw securely (screwdriver and $\frac{1}{2}$ -in. open-end wrench).

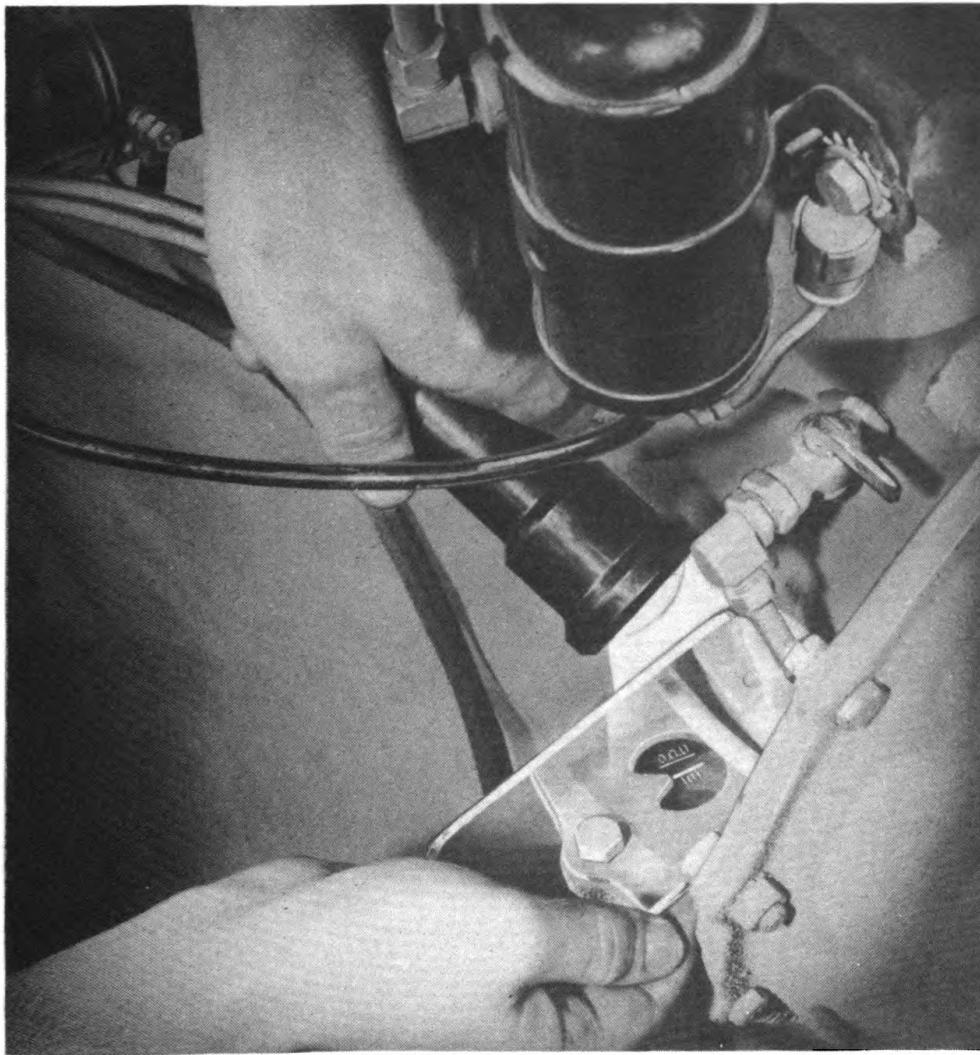
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(c) Connect the primary wire, install the lock washer, and tighten the nut (3/8-in. open-end wrench).

(d) Wipe off the distributor cap both inside and out and install the cap, being sure that the locating lug engages the recess in the distributor body. Latch the cap retainer springs. Make certain that the secondary cables are all seated in the cap towers and that the rubber shields are pushed down over the high tension towers.

(e) Install the engine with clutch and transmission as directed in paragraph 55.

(f) If neon timing light WEI-892 is available, connect it in the No. 1 (rear) spark plug circuit and start the engine (fig. 39). Run the engine at idling speed after its normal operating temperature is reached. If further timing adjustment is necessary, loosen the distributor clamp



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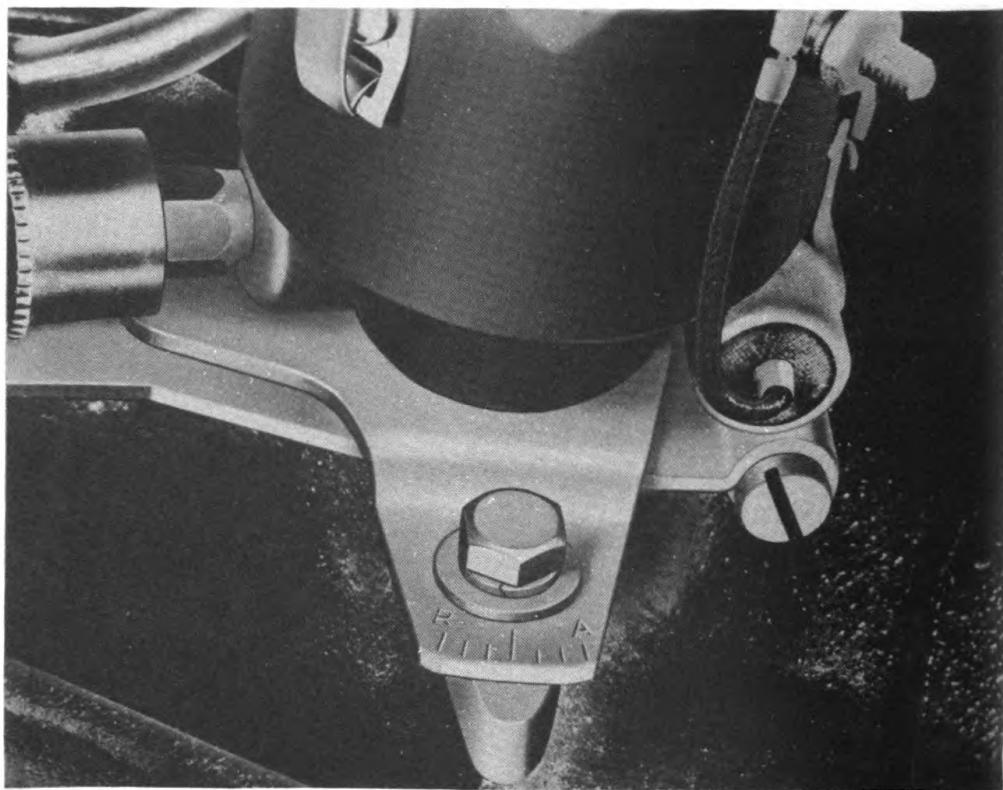
LIGHT CARGO CARRIER T-15

(screwdriver and $\frac{1}{2}$ -in. open-end wrench) and adjust until the flash and the (IGN) timing mark (this mark is approximately $1\frac{3}{4}$ -inch ahead of the UDC 1-6 mark on the flywheel) are exactly synchronized. Because of the angularity involved in viewing the timing marks, a mirror can be used to great advantage in making an accurate check of the timing. Tighten the distributor clamp screw.

(g) Loosen the octane selector screw ($\frac{7}{16}$ -in. open-end wrench), and adjust by moving the distributor slightly clockwise to advance the timing or counterclockwise to retard it to get the best engine performance for the particular fuel in use. Tighten the screw (fig. 40).

b. Contact Points.

(1) MAINTENANCE. Distributor contact points are judged entirely on appearance when considering whether or not they must be cleaned or replaced. The ideal condition of contact points is indicated by the appearance of a smooth grey surface (similar to dark frosted glass). Such points must never be filed or cleaned and need not be replaced. Ordinarily, if the points are oil soaked they need not be filed, but they should be cleaned carefully with SOLVENT, dry-cleaning. In addition, the distributor base plate must be cleaned and inspected for the purpose of discovering the source of the oil. The cause should be eliminated to avoid further trouble.



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When one point is pitted and the other has a slight projection, the points may be cleaned successfully and then squared by filing. The gap must then be readjusted (par. 60 b (3) (e) below). When the points are coated with a blue or black scale, this is an indication that oxidation is occurring. If the scale is cleaned off, the points should prove satisfactory for further service. Under such circumstances, the coil or condenser, or both, may be at fault. If the oxidation continues it will be advisable to replace first the condenser, and if little or no improvement is noticed, then replace the coil, unless facilities for testing the coil and condenser are available. When proper testing equipment is at hand, it can be determined which of the units is at fault. When points are badly pitted, burned, or their surfaces have become round by incorrect filing, it is preferable to replace the points rather than attempt salvage by further filing.

(2) REMOVAL OF CONTACT POINTS.

Tools as listed in paragraph 60 a (2) **WRENCH**, set, combination, electric, WMS-1285P

- (a) Remove the distributor assembly as outlined in paragraph 60 a (2).
- (b) Pull the rotor straight upward and off the distributor cam shaft.
- (c) Loosen the inner nut ($\frac{3}{8}$ -in. open-end wrench) on the primary connector post to loosen the post, remove the hairpin spring holding the contact arm on the pivot post, and pull the arm up and out of the distributor base to free the contact arm spring from the primary post and insulators.
- (d) Loosen the lock nut and unscrew the contact screw (two $1\frac{5}{64}$ -in. open-end wrenches).

(3) INSTALLATION OF CONTACT POINTS.

Tools as listed under paragraph 60 b (2)

GAGE, feeler, 0.001-in. **SCALE**, spring, HKM-J544S

INDICATOR, distributor point **TOOL**, distributor point alining, gap dial, UMS-40 AEE-38

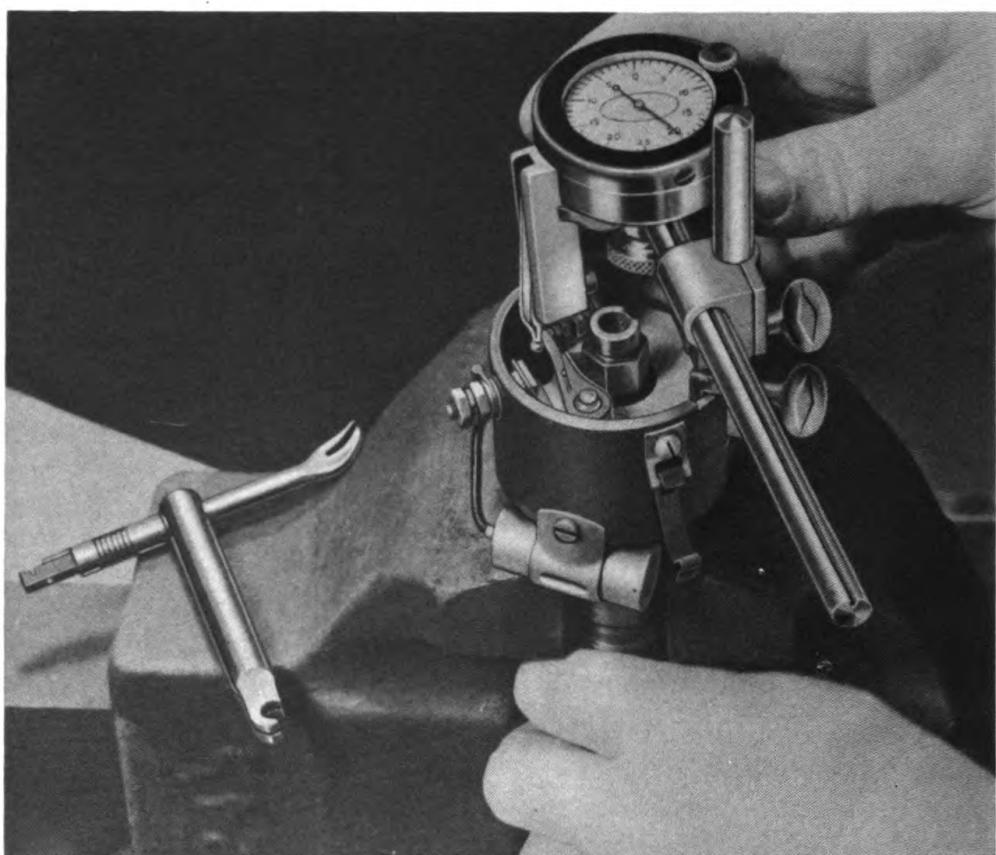
- (a) Install the contact screw lock nut and contact screw in the support, leaving the lock nut loose.

- (b) Install the contact arm, starting the notched end of the flat arm spring over the primary post between the square base and the square washer and making sure the fiber insulator is in place between the flat side of the spring and the distributor body.

- (c) Install the hairpin spring over the contact arm pivot bearing, and, after alining the insulators and primary post, tighten the post inner nut securely. If the screw point and arm point do not meet in perfect alinement it will be necessary to bend the support to obtain alinement. Use distributor point alining tool AEE-38 (fig. 41).

- (d) Loosen the screw (screwdriver) holding the condenser to the distributor body and slip the condenser attaching ears out from under

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Figure 41—Checking Distributor Contact Point Gap with Dial Indicator UMS-40 and Alignment Tool AEE-38

the screw head to clean thoroughly the area of the distributor body under the condenser, as well as the condenser. Use a piece of CLOTH, emery, to rub the contact areas of the body and condenser in order to establish the best possible grounds. Reinstall the condenser and tighten the screw securely.

(e) Turn the distributor shaft until the fiber rubbing block of the arm is exactly on the high point of one of the cam lobes. Adjust the gap (distributor point gap dial indicator, UMS-40) between the point face of the contact screw and the point face of the contact arm to a clearance of 0.020-inch by turning the contact screw in the support (fig. 41). Tighten the screw lock nut securely and recheck the gap. With the points together, attach the hook of spring scale HKM-J544S near the point end of the contact arm. A tension of 17 to 20 ounces should register on the scale when pulling at a right angle to the arm until the points just separate (fig. 42).

(f) Aline the recess in the rotor with the distributor cam shaft and push the rotor down as far as it will go.

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(g) Install distributor assembly as outlined under paragraph 60 a (3).
c. **Ignition Timing.** NOTE: Wherever contact points are reset or replaced, the ignition timing must be checked by either of the following methods:

(1) **TIMING WITH NEON LIGHT.**

(a) Connect neon timing light WEI-892 in the No. 1 (rear) spark plug circuit and start the engine. The (IGN) mark on the engine flywheel should appear in alignment with the pointer on the engine front plate at each flash of the timing light (fig. 39).

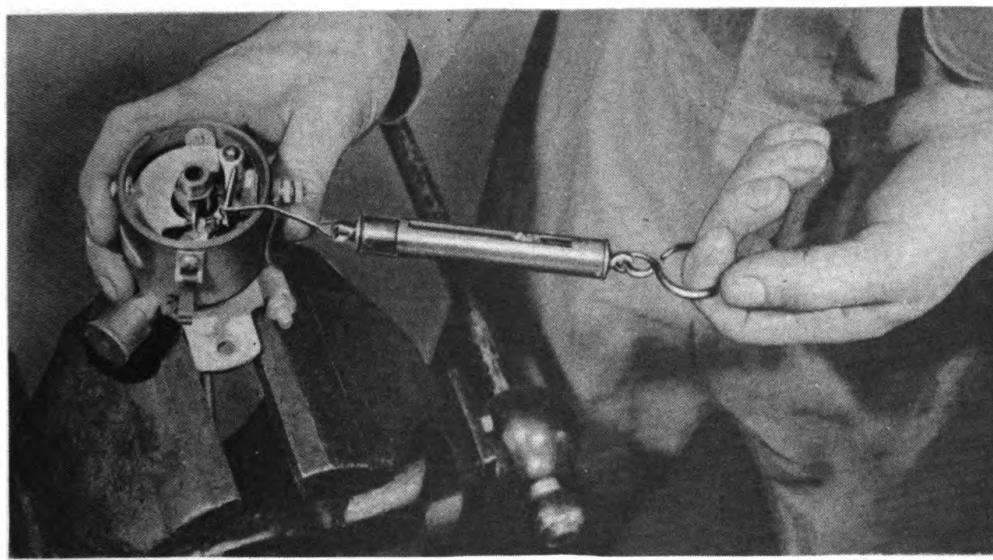
(b) If adjustment is necessary, loosen the distributor clamp (screw-driver and $\frac{1}{2}$ -in. open-end wrench) and turn the distributor until the flash occurs when the mark appears in alignment with the pointer. Tighten distributor clamp.

(2) **IGNITION TIMING USING HAND CRANK.**

(a) Hand-crank the engine until No. 1 piston starts up on its compression stroke and then continue to crank engine until the ignition mark (IGN) is directly under the timing pointer of the engine rear plate. At this point, No. 1 piston is in firing position.

(b) Place a piece of cellophane or a 0.001-inch feeler gage between the distributor contact points (points fully closed).

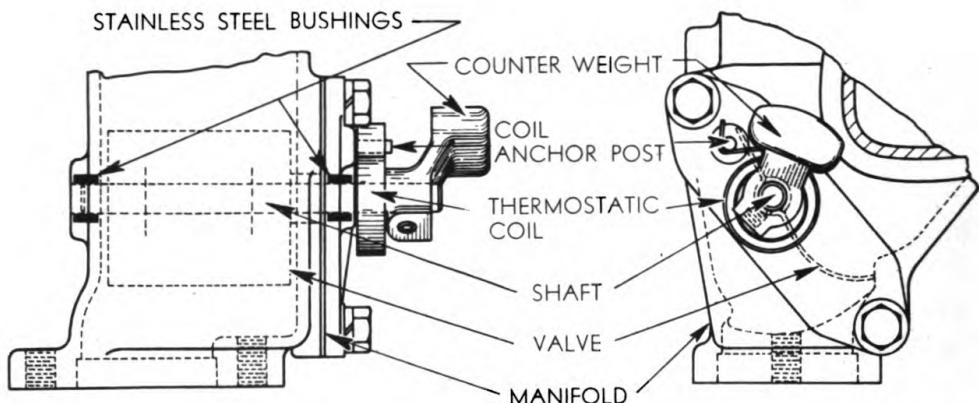
(c) Rotate distributor housing to a point where the 0.001-inch feeler, still supported by the points, can be withdrawn with only a slight drag. Tighten the distributor clamping bolt.



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Figure 42—Checking Distributor Breaker Arm Tension with Scale HEM-J544S

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Figure 43—Manifold Heater Valve Construction

(d) Hand-crank the engine until the mark (IGN) is again aligned with the pointer and check the distributor as in (c) above.

(e) Install distributor rotor and cap, making certain that all high-tension cables are properly seated in their respective recesses in the distributor cap and that the rubber cable shields are pushed down over the high tension towers.

d. **Ignition Coil.** The ignition coil is located at the right front side of the engine and is mounted on a bracket which is secured to the cylinder head by a cylinder head cap screw (fig. 16). The coil may be disconnected by pulling out the high tension wire from the coil tower, removing the front wire on the coil which runs to the ignition switch at the instrument panel, and removing the rear wire to the distributor after removing the nuts and lock washers ($\frac{3}{8}$ -in. open-end wrench). Check the coil using a suitable tester. To remove the coil, drain the coolant from the cylinder block; then remove the cylinder head cap screw ($1\frac{1}{16}$ -in. socket wrench and flex handle) and lift the coil and mounting bracket off the cylinder head. The mounting bracket can be removed from the coil if necessary (two $\frac{1}{2}$ -in. open-end wrenches). Note that flat and star washers are used between the mounting bolt and bracket and a lock washer and nut on the other side of the bracket.

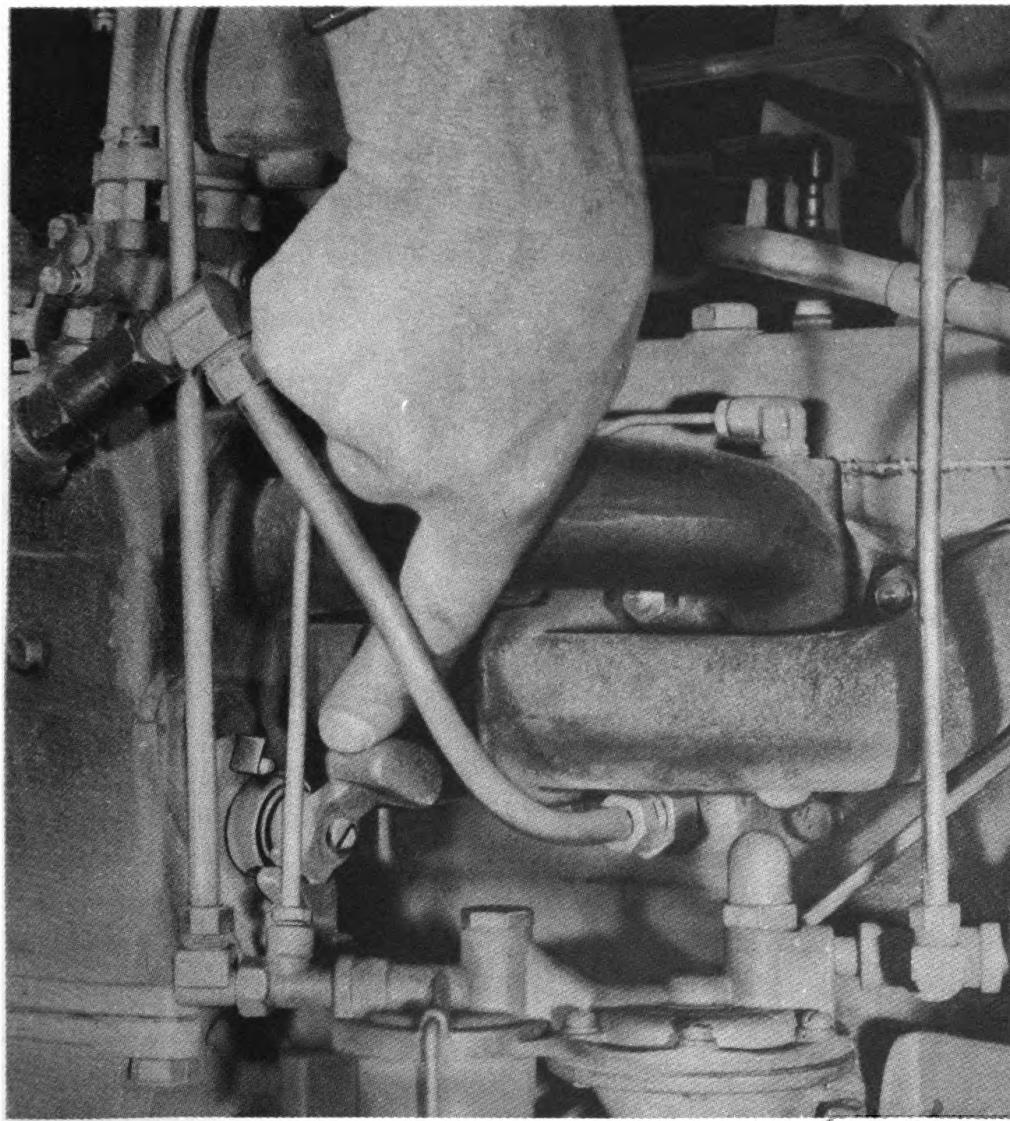
e. **High Tension Wiring.** The distributor to coil and spark plug wires are heavily insulated to withstand wear and deterioration. If a faulty wire is discovered, a new cable of the same length and quality should be installed. No special servicing instructions are required other than a caution to make sure good contact is obtained and the cover boot is installed over the distributor cap.

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61. CARBURETOR.

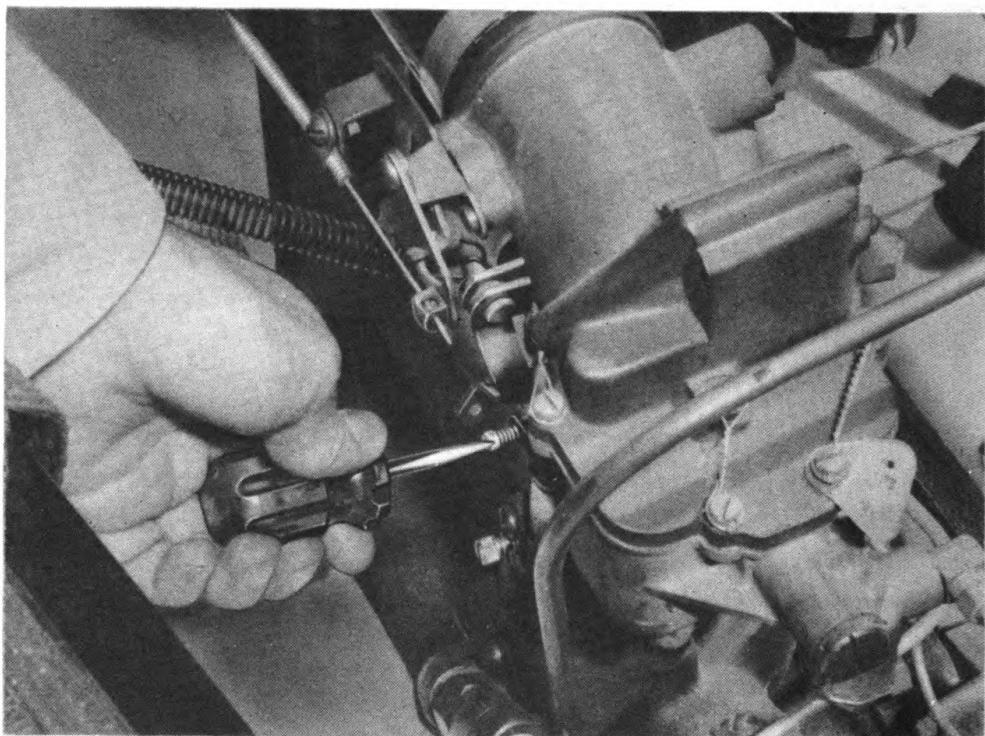
a. **Adjustments.** The only external adjustments which can be made to the carburetor are: idle mixture adjustment, throttle stop screw, and choke control.

(1) **MANIFOLD HEAT CONTROL VALVE.** First, make sure that the manifold heat control valve is free (fig. 44). Determine this by attempting to move by hand the counterbalance weight (at rear of heat riser). The counterbalance should move easily and spring back. If the valve shaft is seized, it will be necessary to free the shaft in its bearings. To do this, remove the manifold as outlined in paragraph 57 a (7) and the 2 valve retaining cap screws ($\frac{1}{2}$ -in. box wrench); then remove the valve,



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RA PD 49356

Figure 45—Adjusting Carburetor Throttle Stop Screw

cover, and shaft assembly turning the valve and shaft as necessary for the valve to clear the manifold opening (fig. 43). Take out the counterbalance set screw ($\frac{7}{16}$ -in. open-end wrench), remove the counterbalance, and pull the thermostat spring out of the slot in the rear end of the shaft. Then pull the shaft out of the cover and reduce the diameter of both ends of the shaft, using CLOTH, abrasive, sufficiently to free shaft. Clean shaft thoroughly to remove all trace of grit. Do not enlarge the steel bushings because they are coated with a protective scale and if removed will only reform and again seize the shaft. Reassemble the shaft, thermostat spring, cover, and counterbalance. Using a new gasket, install the front end of the shaft in the manifold bushing. Install the cover and the 2 cap screws securely. Reverse the removal procedure when reinstalling the manifold and use new gaskets.

(2) IDLING ADJUSTMENTS. Run the engine until the heat indicator on the instrument panel registers 175 degrees F, indicating that the engine has warmed to its normal operating temperature. Be sure that the choke valve is open fully with the button on the instrument panel all the way in. Adjust the throttle stop screw (screwdriver) until the ammeter just shows charge (fig. 45). Turning the screw clockwise will

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increase the engine idling speed, while turning it counterclockwise will reduce the engine idling speed. Adjust the idle mixture by turning the adjusting screw in or out a slight amount with the fingers or a screwdriver to obtain the smoothest idle performance possible (fig. 46).

(3) **CHOKE ADJUSTMENT.** Loosen the choke linkage to control wire collar screw (screwdriver) and push the choke valve all the way open. Push the choke control button all the way in and, while holding the choke valve in the fully opened position, tighten the linkage collar screw to lock the choke control wire. Open and close the choke valve and check the adjustment.

b. Carburetor Removal.

HANDLE, flex

WRENCH, box, $\frac{3}{8}$ -in.

SCREWDRIVER

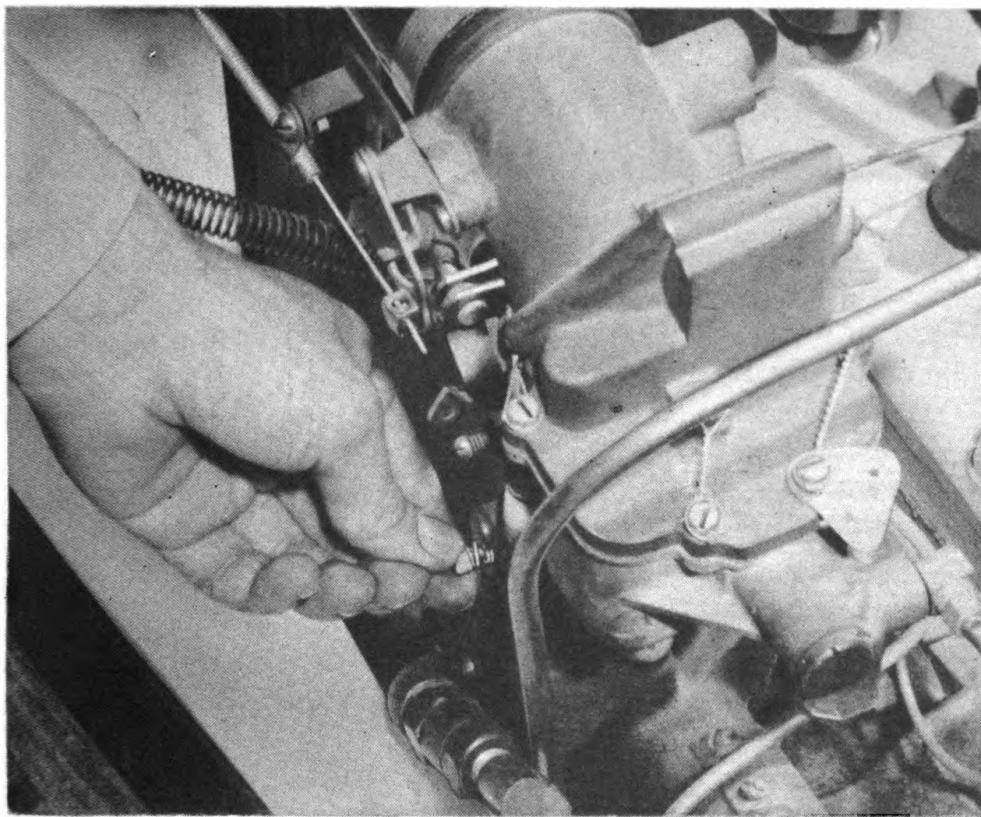
WRENCH, open-end, $\frac{7}{16}$ -in.

SOCKET, $1\frac{1}{16}$ -in.

WRENCH, open-end, $\frac{9}{16}$ -in.

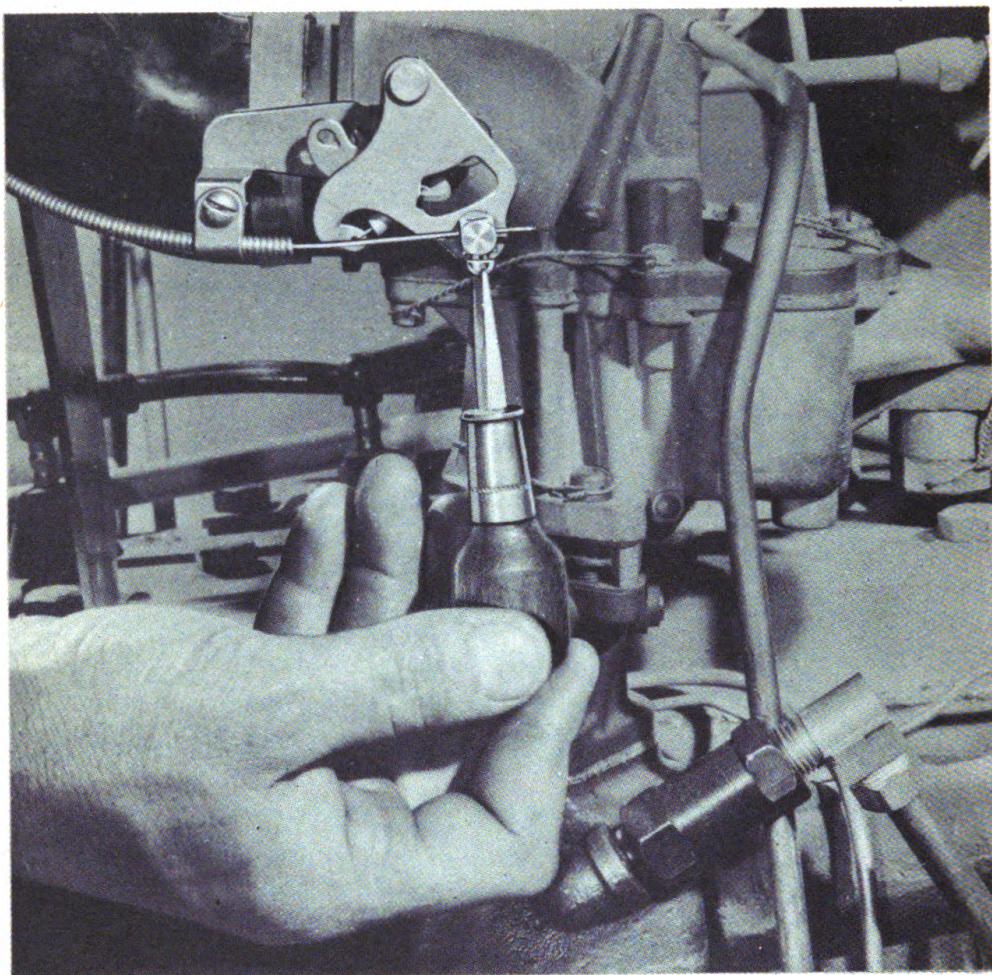
(1) Raise the engine compartment cover.

(2) Loosen the air intake elbow to carburetor throat clamp screw ($\frac{3}{8}$ -in. box wrench) and loosen the air intake elbow support bracket by loosening the cylinder head cap screw ($1\frac{1}{16}$ -in. socket and flex handle)



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RA PD 49401

Figure 47—Carburetor Choke Control Adjustment

Push the air intake elbow, support bracket, and air cleaner forward and off the carburetor.

(3) Disconnect the throttle pull back spring and remove the clevis pin in the accelerator cable to carburetor attaching clevis.

(4) Disconnect the choke control wire from the choke adjustment collar and the cable from the linkage bracket (screwdriver).

(5) Disconnect the fuel line at the carburetor ($\frac{7}{16}$ -in. open-end wrench).

(6) Remove the 2 nuts ($\frac{9}{16}$ -in. open-end wrench) and lock washers holding the carburetor to the manifold. Lift off the carburetor assembly with gasket.

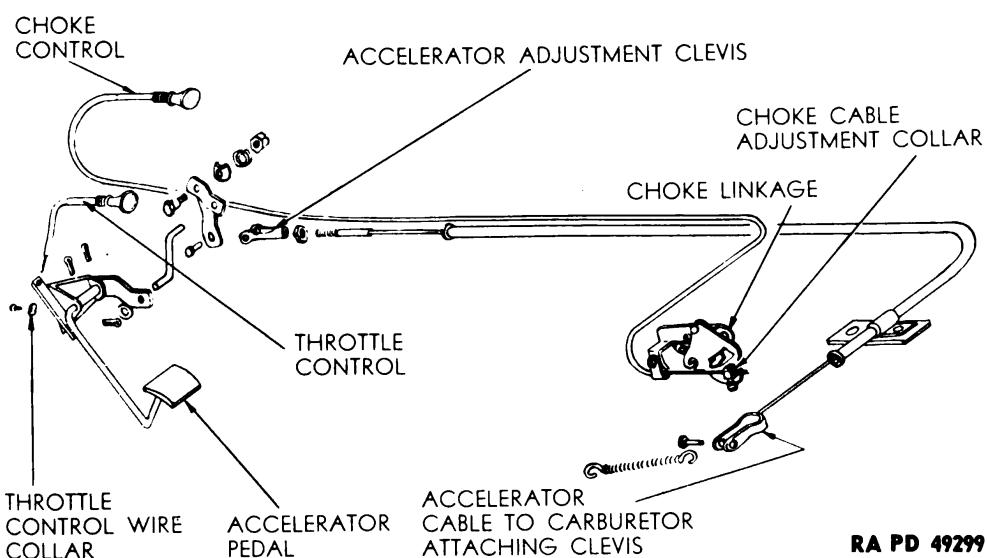
c. **Carburetor Installation.** When installing the carburetor, reverse the removal procedure and use a new gasket. Readjust the choke control, the idle stop screw, and the idle mixture screw (par. 61, a (2) (3)).

d. **Accelerator Adjustment.** To adjust the throttle linkage, first

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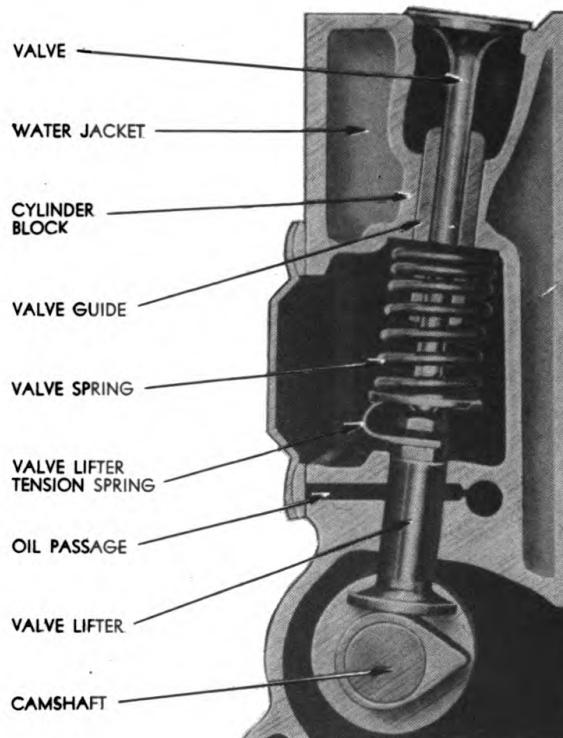
adjust the throttle stop screw (par. 61 a (2)) until the ammeter just registers charge. Then at the accelerator pedal, loosen the throttle-control-wire-collar screw (screwdriver) (fig. 48) and reset the collar on the throttle control wire to assure full throttle closing at the throttle stop screw on the throttle shaft operating arm of the carburetor. If the throttle valve does not open completely as indicated by the fixed stop on the throttle shaft operating arm when the accelerator is fully depressed, loosen the throttle-control-wire-collar, loosen the accelerator adjustment clevis lock nut ($\frac{3}{8}$ -in. open-end wrench), and remove the accelerator bell crank cotter pin and clevis pin (pliers). Turn the clevis clockwise to shorten the effective length of the cable in order to raise the accelerator pedal to provide the pedal travel required for full throttle opening. Install the pin and a new cotter pin, tighten the clevis lock nut, and reset the throttle control wire collar to obtain the proper closed throttle idle position. Check the adjustments to make sure that when the accelerator pedal is depressed fully, the throttle valve fixed stop on the operating arm contacts the boss on the carburetor; also when the accelerator pedal is fully released, that the throttle stop screw is in full contact with the boss on the carburetor.

e. **Hand Throttle Adjustment.** With the hand throttle control button in the fully closed position against the instrument panel, loosen the throttle-control-wire-collar-screw (screwdriver). Hold the control wire collar against the accelerator upper operating arm and tighten the collar screw (fig. 48).



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Figure 49—Valve and Related Parts

62. OIL PRESSURE GAGE.

a. Oil Pressure Gage Removal.

WRENCH, open-end, $\frac{3}{8}$ -in. WRENCH, open-end, $\frac{1}{16}$ -in.

(1) Disconnect the oil pressure pipe at the gage by uncoupling the fitting ($\frac{1}{16}$ -in. open-end wrench) on the underside of the instrument panel (fig. 105). Bend the pipe enough to be out of the way.

(2) Remove the nuts ($\frac{3}{8}$ -in. open-end wrench) and lock washers from the studs on the gage to permit removal of the clamp bracket. Pull the gage out from the face of the panel.

b. Adjustment. The pressure gage is not adjustable. If it is determined that the gage is inaccurate or inoperative, replace it with a new gage.

c. Oil Pressure Gage Installation. Reverse the removal steps to install the gage.

63. VALVES.

NOTE: It is necessary to remove the engine and cylinder head to obtain access to the valves and valve mechanism (fig. 49). Reconditioning the valves requires the use of precision refacing and grinding equipment and the operations involved are performed only by trained ord-

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nance personnel. Likewise, this applies to the replacement of valves, springs, retainers, and valve lifters with adjusting screws.

a. Valve Adjustment.

Tools as listed in paragraph 55 a.

SCALE, spring, HKM-1336A

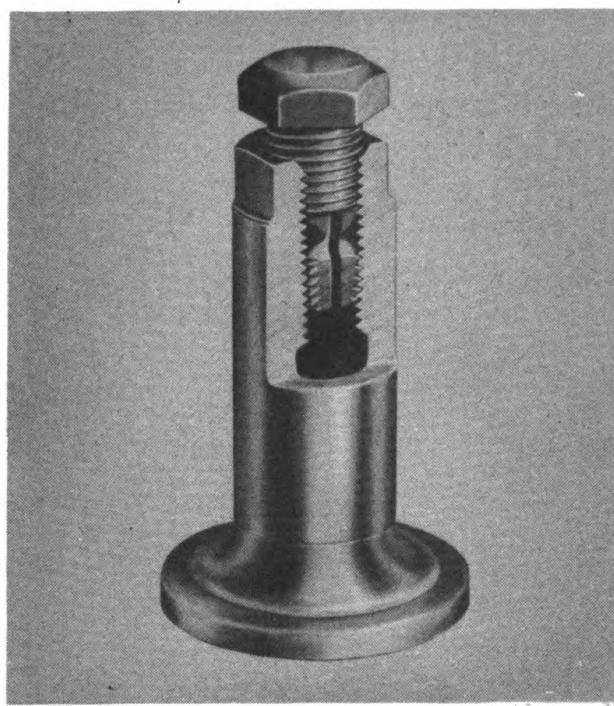
FEELER stock, tappet,

WRENCHES, tappet, $\frac{1}{2}$ -in.

SD-AC300

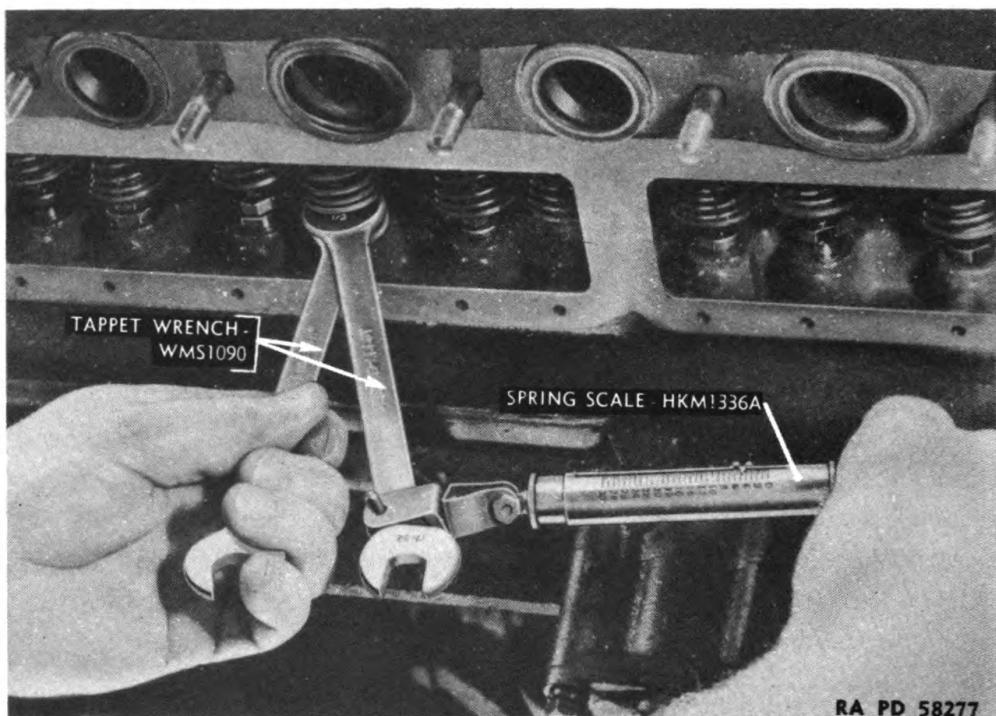
WMS-1090 (2)

- (1) Remove the engine (par. 55 a).
- (2) Remove the engine manifold (par. 57 a).
- (3) Remove the valve cover screws ($\frac{1}{2}$ -in. box wrench), remove the valve covers, and scrape off the gaskets. Use GREASE, general purpose, to apply new cover gaskets on reassembly.
- (4) The valve lifter adjusting screws for each cylinder should be adjusted according to the engine firing order 1-5-3-6-2-4 as each piston, in turn, is moved to upper dead center by cranking the engine. Valve adjustment consists of setting the lifter screw to valve stem clearance at 0.016-inch, engine cold, using SD-AC300 feeler stock and two $\frac{1}{2}$ -inch tappet wrenches (fig. 51). The clearance between the upper face of the screw and the lower face of the valve stem is adjusted by holding on the flats of the lifter with a $\frac{1}{2}$ -inch tappet wrench while the screw is turned clockwise with another $\frac{1}{2}$ -inch tappet wrench to increase the clearance, or counterclockwise to reduce the clearance. The self-locking



RA PD 49325

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RA PD 58277

Figure 51—Checking Valve Lifter Adjusting Screw Tension

valve lifter screws will function satisfactorily when there is a resistance in turning of at least 25 inch-pounds (4-lb pull when measured with spring scale HKM-1336A at the end of a 6-inch wrench). If turning resistance of the valve lifter screw is less than specified (4 pounds pull when measured with spring scale HKM-1336A at the end of a 6-inch wrench), notify ordnance personnel.

(5) Assemble the parts removed, using new gaskets, by reversing the procedure followed for removal.

b. Compression Test of Engine.

GAGE, compression, AEE-G4 WRENCH, spark plug,

HANDLE, spark plug wrench,

SD-512819

SD-665327

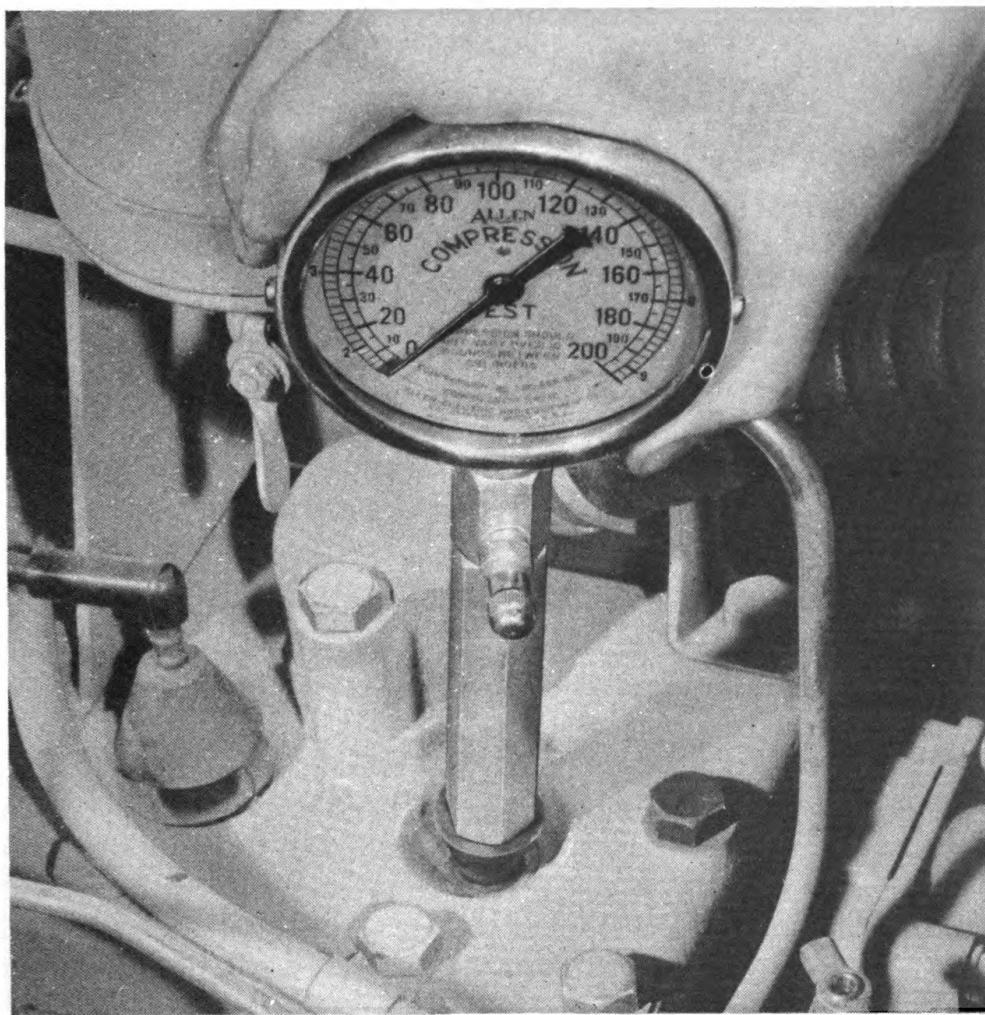
The general condition of the engine valves and piston rings can be determined by making a compression test of each of the engine cylinders. To perform this operation, run the engine until it has reached its normal operating temperature (175 F). With the ignition switch in the off position, remove all the spark plugs according to the procedure given in paragraph 59 a. Open the carburetor throttle valve by pulling the throttle control button outward. Insert compression gage AEE-G4 in each spark plug hole in the cylinder head and crank the engine with the starter motor until the gage reaches its highest reading (fig. 52). If

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readings of approximately 105 pounds are obtained, the valves and piston rings are in good condition. If the test results are not uniform or the average figure is believed to be low by comparison, make a complete report to the ordnance officer in charge or to the responsible maintenance personnel. On completion of the compression test, service and install the spark plugs as directed in paragraph 59 b and c.

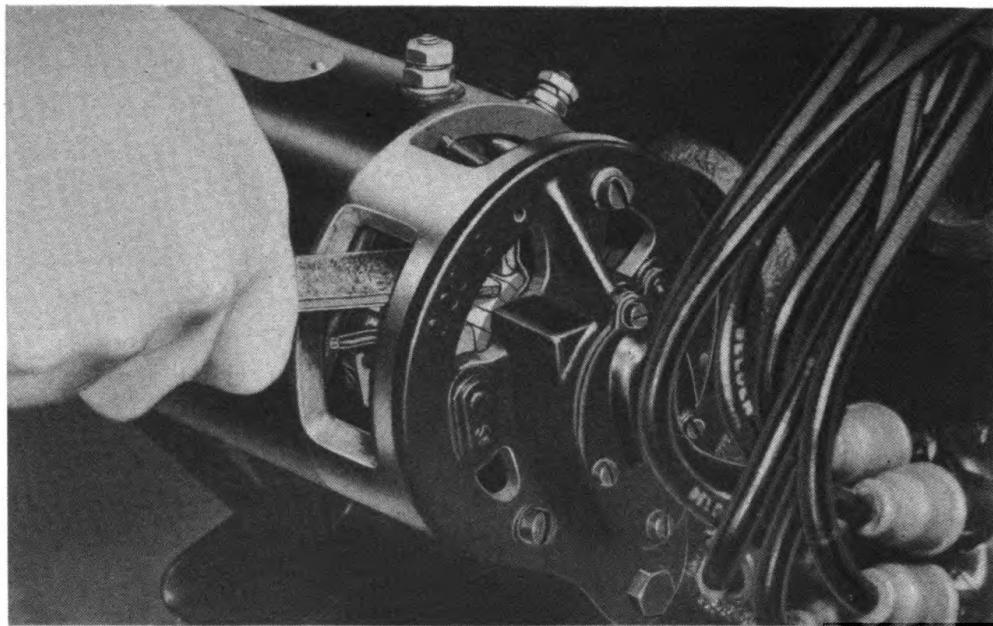
64. GENERATOR.

a. **Description.** The 12-volt generator used in this vehicle is a high output, fully controlled, shunt wound type having a 40-ampere capacity. It is mounted at the extreme rear of the engine on the right side. Two hinge bolts underneath the generator body and an adjusting arm with pivot and clamp bolts hold the generator in any desired position as



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RA PD 49326

Figure 53—Cleaning Generator Commutator

limited by the length of the driving belt. Aside from being mounted directly in the air stream of the engine compartment, the generator is equipped with a cooling fan which is welded to the drive pulley and turns at armature speed. Two brushes are used in the generator, one ground and one field. The output of the generator is controlled by the generator regulator.

b. Servicing.

(1) **LUBRICATION.** The armature runs on fully housed ball bearings. Oilers are fitted over the front and rear bearings in the generator end plates to permit proper lubrication as directed in Section V, "Lubrication." Care should be used when oiling the generator because over-lubrication is harmful.

(2) **GENERATOR COMMUTATOR.** Periodically or at the lubrication periods, remove the cover at the front end of the generator by loosening the cover clamp screw (screwdriver) and slipping the cover forward over the end of the generator (fig. 53). When the cover has been removed the commutator and brushes can be examined. The brushes should seat firmly on the commutator bars and there should be a minimum of arcing while the armature is in motion. If the commutator appears to be black, greasy, or pitted, if the brushes are worn badly and unevenly, or if there is excessive arcing when the commutator rotates, replace the generator.

If the commutator is only dirty, it may be cleaned successfully in the

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field. Use **PAPER**, flint, No. 00, in a strip exactly the width of the commutator and hold it against the commutator while it is rotating. A thin strip of wood about $\frac{1}{8}$ -inch thick and the same width as the commutator may be used to hold the paper against the rotating commutator. The top of the stick should be inclined toward the engine so that it has a trailing action on the commutator. The strip of paper must be of sufficient length to permit holding it securely on the stick with the same fingers used to hold the strip. Use care not to move the arm or hand into the path of the fan blades. After the commutator has been cleaned, position the cover and tighten the clamp screw securely.

c. Generator Removal.**SCREWDRIVER****WRENCH, box, $\frac{1}{2}$ -in.****WRENCH, box, $\frac{7}{16}$ -in.****WRENCH, open-end, $\frac{1}{2}$ -in.**

- (1) Open the engine compartment lid.
- (2) Loosen the generator adjusting arm pivot screw ($\frac{1}{2}$ -in. open-end wrench) at the front of the cylinder block. Disconnect the brown wire ($\frac{1}{2}$ -in. box wrench), black wire ($\frac{7}{16}$ -in. box wrench), and the red ground wire (screwdriver).
- (3) Loosen the adjusting arm clamp bolt at the generator rear end plate ($\frac{1}{2}$ -in. open-end wrench).
- (4) Loosen the generator hinge bolts ($\frac{1}{2}$ -in. open-end and $\frac{1}{2}$ -in. box wrenches) and push the generator toward the engine. Remove the adjusting arm clamp bolt and move the adjusting arm up and out of the way. Remove the hinge bolt nuts and, while holding the generator, remove the hinge bolts and rear spacer.
- (5) Disengage the generator pulley from the fan belt and lift the generator out of the engine compartment.

d. Generator Installation. To install the generator, reverse the removal procedure given in paragraph 64 c. When installing a replacement generator, see that it is lubricated adequately, connected properly, and that the fan drive belt tension is adjusted as directed in paragraph 74 d.

65. STARTING MOTOR.

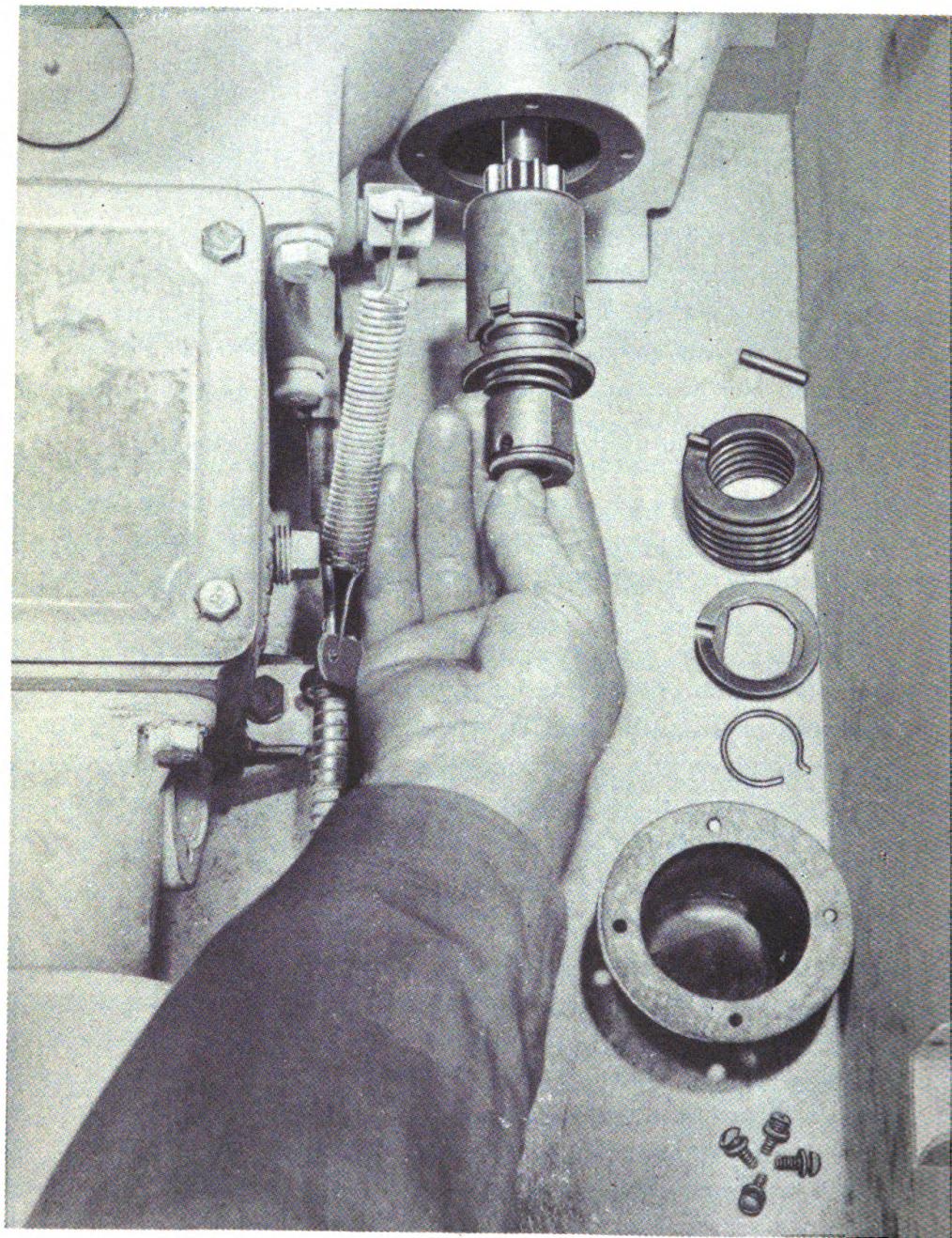
a. Description. The 12-volt starting motor is used to crank the engine. It is secured to the engine front plate at the left of the engine by fastening bolts extending through the engine front plate and the clutch housing. The starting motor cranks the engine through a Bendix torque spring drive. Starter action is controlled by a finger operated push button switch on the instrument panel and a solenoid switch on the engine side of the bulkhead. When the starter switch button is pushed the solenoid is energized, and an electric magnet draws heavy high capacity copper contacts together to close the starter motor circuit and set it in motion.

At the instant the circuit is closed and the starting motor armature starts

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to rotate, inertia of the counter-weighted Bendix pinion causes it to lag behind the starter armature rotation speed. This action results in the pinion being drawn into mesh with the gear teeth on the outer rim of the engine flywheel. At the point where full tooth engagement of the pinion and flywheel gear is accomplished, a flange on the pinion halts further rearward movement of the pinion and the armature shaft begins to turn the engine flywheel. To relieve the shock on the armature shaft



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as the full load is reached, a heavy coil drive spring is employed between the armature shaft and the pinion shaft. When the engine starts, the increased speed of the flywheel relieves the tooth pressure of the pinion on the flywheel gear. The long pitch thread as well as the recoil of the drive spring throws the pinion out of mesh and forward away from the flywheel gear.

b. Servicing.

(1) **BENDIX DRIVE.** The Bendix drive parts require no attention except that they should be kept thoroughly clean. No oil is required. To inspect and clean the drive, remove the 4 screws (screwdriver) holding the cover to the front face of the clutch housing. Remove the cover carefully to avoid injuring the gasket (fig. 54). Wipe the screwdriver with a clean rag. If congealed oil is present on the parts, soak the drive with SOLVENT, dry-cleaning, and then wipe away all traces of oil, grease, and solvent. If for any reason it is necessary to remove the Bendix drive parts, remove the cover as outlined previously. Using a screwdriver, remove the snap ring, lock, and spring. With a punch and hammer, drive out the pin securing the drive parts to the starter motor armature shaft and slide the remaining drive parts off the shaft.

(2) **REAR STARTING MOTOR BEARING LUBRICATION (BULKHEAD OFF VEHICLE).** The oiler lid at the rear of the starter motor must be pushed aside to lubricate the rear bearing as directed in section V, "Lubrication". On completion of the operation, return the oiler lid to seal the lubrication hole.

(3) **STARTING MOTOR COMMUTATOR.** Examine the starter commutator whenever the engine is removed. To do this, loosen the cover band clamp screw (screwdriver) at the rear of the starting motor and push it rearward off the end of the starting motor. If the commutator is black in color or if the 4 brushes are worn badly, replace the starting motor. If the commutator is merely dirty and the brush action and brushes are satisfactory, remove the starter from the engine and clean the commutator in the same manner as directed in paragraph 64 b (2) for the generator commutator.

c. Starting Motor Removal.

WRENCH, box, $\frac{9}{16}$ -in.

WRENCH, open-end, $\frac{9}{16}$ -in.

(1) Remove the engine as directed in paragraph 55.

(2) Disconnect the cable at the starting motor ($\frac{9}{16}$ -in. open-end wrench). Remove the 3 clutch housing bolts, nuts, and lock washers ($\frac{9}{16}$ -in. open-end and $\frac{9}{16}$ -in. box wrenches) that hold the starter to the front engine plate and clutch housing. Lift the starting motor with Bendix drive out of the clutch housing and away from the engine.

d. Installation.

(1) The starting motor is installed by reversing the procedure followed for removal as given in paragraph 65 c.

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66. ENGINE INSTALLATION.

a. Equipment.

Tools as listed in paragraph 55 a.

b. Procedure.

(1) The engine is installed in the hull by reversing the removal procedure (par. 55).

(2) As required, new cotter pins and lock washers should be used. LEAD, white, basic-carbonate, should be applied at hose connections. When all connections have been completed, fill the cooling system with coolant, and the crankcase with the proper grade of oil, to their respective levels (par. 53 b). Operate the engine and make a careful inspection for oil, water, and fuel leaks. Check the instruments and controls for proper operation. Check the lubricant level in the transmission and add the correct grade of oil as required (sec. V, Lubrication).

Section XIV

FUEL SYSTEM

	Paragraph
Description	67
Fuel tank	68
Cleaning fuel system	69
Fuel pump	70
Primer	71
Carburetor air cleaner	72

67. DESCRIPTION (fig. 55).

a. The 25-gallon capacity fuel tank is located on a shelf within the engine compartment on the right side and slightly above the engine. The tank is held rigidly in place by 2 band clamps secured over the top of the tank. Gasoline is piped from the tank to the fuel pump where it flows into a reservoir to be strained through a fine gauze screen before entering the pipe connected to the carburetor. As the fuel enters the carburetor it is again strained before entering the carburetor float chamber.

b. The diaphragm-type fuel pump is located at the extreme left rear corner of the engine at camshaft level and immediately in front of the engine rear plate. The fuel pump is actuated by an eccentric forged and ground on the camshaft. The pump makes the following one complete cycle in every 2 revolutions of the crankshaft: gasoline is pulled from the tank into the pump reservoir on the down stroke of the plunger, and the charge is forced into the carburetor float chamber on the up stroke of the plunger. The delivery of fuel to the carburetor is controlled by a sensitive valve in the fuel pump body which acts to render the fuel pump neutral while the carburetor float chamber is full.

c. The purpose and use of the primer has been outlined in paragraph 8. Because its use is limited to starting in subzero temperatures, it is not probable that the primer will require special service other than to keep the connections tight. The primer consists of a pump and a system of pipes—an inlet and an outlet. When the pump piston is pulled rearward, a charge of gasoline is drawn into the cylinder. When the piston is pushed forward, the charge is distributed through the outlet pipe to the three branches of the intake manifold.

d. The carburetor air cleaner for cleaning the engine intake air is mounted ahead of and slightly above the carburetor in the engine compartment. It is connected by a clamp to an elbow fastened to the carburetor air intake throat. The elbow is supported by a welded bracket which is held in position by a cylinder-head cap screw. The cleaner consists essentially of three parts: the cover, the filtering element, and the body. Servicing of the air cleaner is discussed in paragraph 72.

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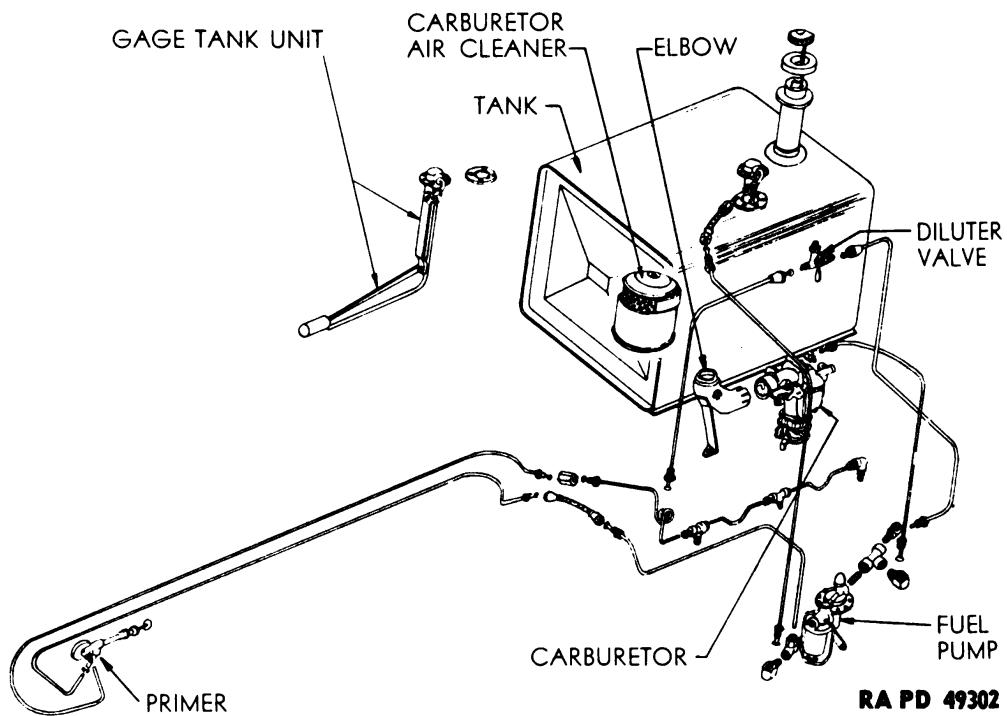


Figure 55—Fuel System Parts

68. FUEL TANK.

a. **Draining and Cleaning.** When it is desired to drain and clean the fuel tank without removing it from the vehicle, proceed as follows:

- (1) Raise the engine compartment lid, remove the battery compartment cover, and disconnect the battery ground strap (par. 55 a (8)).
- (2) Remove the 5 screws (screwdriver) holding the crankcase drain plate to the hull and remove the plate and gasket.
- (3) Remove the fuel tank drain plug (3/8-in. open-end wrench), located on the bottom of the tank, at the rear.
- (4) Clean the tank by pouring in a gallon or more of fuel; rock the vehicle as much as possible in order to dislodge sediment.
- (5) Install the drain plug, hull plate and gasket.

b. **Equipment.** Tools as listed in paragraph 55 a (4), (5), (8), (9), (12), also the following:

SCREWDRIVER

WRENCH, open-end, 1/2-in. (2)

WRENCH, open-end, 3/8-in.

WRENCH, open-end, 1/16-in. (2)

WRENCH, open-end, 7/16-in.

c. **Removal.**

- (1) Remove the engine compartment front lid screen (par. 55 a (4)) and the engine compartment lid with hinge (par. 55 a (5)).

FUEL SYSTEM

- (2) Remove the battery compartment cover and disconnect the battery ground strap (par. 55 g (8)).
- (3) Drain the radiator (par. 55 a (9)) and remove the rear air duct, fan, and radiator (par. 55 a (12)).
- (4) Disconnect the fuel pump pipe at the tank end of the flexible coupling (1/2-in. and 9/16-in. open-end wrenches).
- (5) Disconnect the fuel gage wire at the tank unit terminal (3/8-in. open-end wrench).
- (6) Disconnect the rear marker light wire at the Douglas connection and remove the 2 wire harness clips on the right deck coaming (screwdriver and 9/16-in. open-end wrench). Move the harness away from the top of the fuel tank.
- (7) Allowing the generator regulator to remain fully connected, remove the 4 regulator to bulkhead mounting bolts, nuts, flats, locks, and star washers (1/2-in. open-end wrench). (Note that the star washers are installed between the regulator legs and the bulkhead). Lay the regulator to the left and out of the way.
- (8) Disconnect the oil filter inlet pipe (3/8-in. open-end wrench) and carefully bend the pipe up and to the left out of the way. Disconnect the filter outlet pipe (9/16-in. open-end wrench). Remove the oil filter from its mounting bracket by taking off the 4 mounting bolts, nuts, flats, and locks (two 1/2-in. open-end wrenches). Carefully raise the fuel line pipe

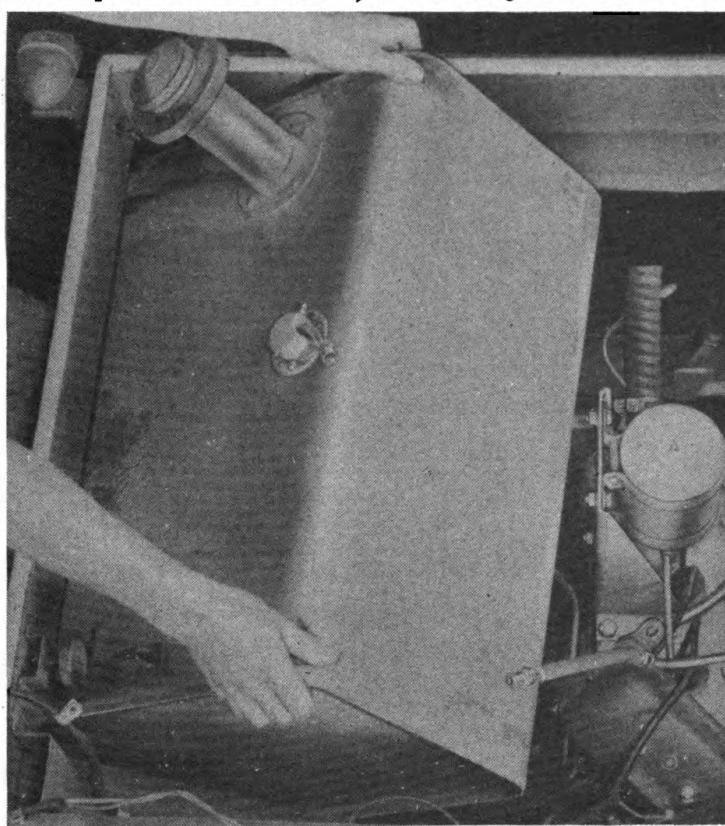


Figure 56—Fuel Tank Removal RA PD 49309

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to the left, and up, out of the way.

(9) Remove the generator to adjusting arm cap screw ($\frac{1}{2}$ -in. open-end wrench) with flat washer and lock washer and, with the same tool, loosen the generator adjusting arm pivot stud nut in order to swing the arm up and to the left.

(10) Remove the 2 gas tank strap clamp bolts with nuts, flats, and locks (two $\frac{3}{16}$ -in. open-end wrenches). Bend the left straps down flat.

(11) Move the fuel tank forward, to the left off its shelf, and raise its left side upward to work the tank out of the engine compartment (fig. 56).

d. Installation. Tools as listed in paragraph 68 b.

(1) Before the fuel tank is installed, GREASE, general purpose, should be applied on the strap surfaces on which the tank rests; this operation will facilitate sliding the tank into position.

(2) If a new tank is installed, it will be necessary to remove the screws (screwdriver) fastening the fuel gage tank unit in order to install the unit onto the new tank. A new gasket should be used to avoid the possibility of any leakage at this point.

(3) Reverse the steps given for removal (par. 68 c) to install the tank and other units involved in the operation. After filling the fuel tank with gasoline, check for any leakage with the engine running.

e. Fuel Gage System. The driver is able to tell at a glance the approximate amount of fuel in the tank by means of an electric fuel gage consisting of the dash unit, the tank unit, and the electrical gage circuit.

(1) The fuel gage dash unit may be removed from the instrument panel after performing the following operations: Use a $\frac{3}{8}$ -inch open-end wrench to remove the 2 terminal nuts and locks on the back of the gage. Take off the resistance unit from the right terminal post and the black and red wire from the left post. (There is no current in the wires when the ignition switch is off.) Remove the 2 nuts ($\frac{3}{8}$ -in. open-end wrench) holding the gage to the instrument panel. The U-clamp on the gage terminal posts can be removed and the gage can be pulled out from the face of the panel.

(2) The electrical connection at the tank unit can be removed after the terminal nut and lock are removed ($\frac{3}{8}$ -in. open-end wrench). The fuel line is disconnected at the flexible coupling near the tank unit ($\frac{1}{2}$ -in. and $\frac{3}{16}$ -in. open-end wrenches). To replace the tank unit, remove the 5 screws (screwdriver) which fasten the unit to the tank.

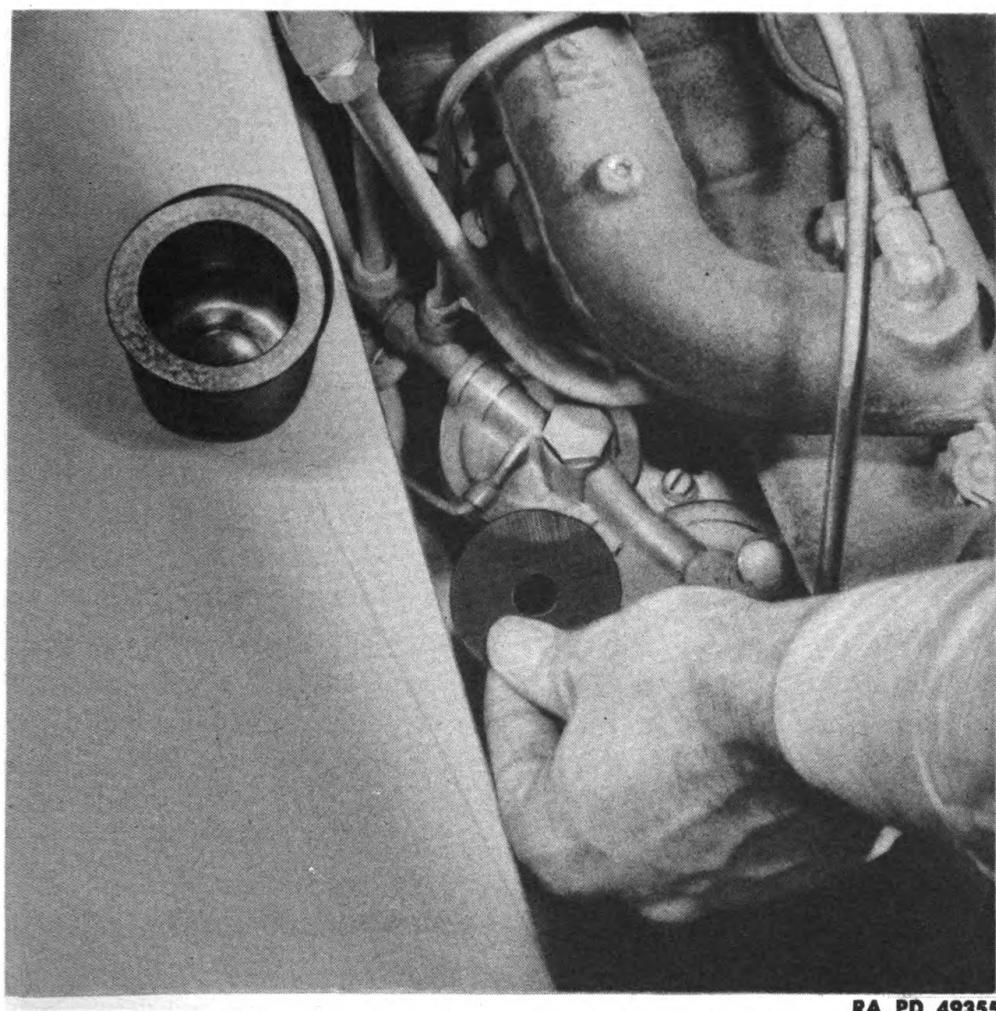
(3) When difficulty is experienced with the fuel gages and it is desired to determine whether the dash unit or tank unit is at fault, make a test with a tank unit that is known to be accurate. The test is made by disconnecting the gage wire from the vehicle's tank unit and attach-

FUEL SYSTEM

ing it to the test unit. The test unit must then be grounded on the vehicle, the ignition switch turned on, and the float of the test unit raised and lowered by hand. If, when raising and lowering the float of the test unit, the dash gage registers properly, there is an indication that the difficulty lies in the tank unit. If another test does not change the situation, the tank unit must be replaced. On the other hand, if raising and lowering the float has no effect on the dash unit, the trouble lies in the dash unit or circuit. If this is the case, the dash unit must be replaced provided the circuit has been checked and connections cleaned and tightened.

69. CLEANING FUEL SYSTEM.

- a. **Tank.** Cleaning and removal of fuel tank is outlined in paragraph 68.
- b. **Lines.** The fuel lines may be cleaned by disconnecting both ends and blowing through them or using compressed air, if available.



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Figure 57—Fuel Pump Screen Removal

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c. Strainer.

(1) To clean the fuel pump strainer, proceed as follows:

(a) To prevent loss of fuel when cleaning the fuel pump strainer, remove the gasoline tank cap and disconnect the fuel pump line at the tank end of the flexible coupling ($\frac{1}{2}$ -in. and $\frac{7}{16}$ -in. open-end wrenches).

(b) Reaching over the left deck at the side of the engine compartment with the lid fully raised, loosen the fuel pump bowl retainer nut; swing the yoke and nut toward the engine, and remove the bowl, gasket, and strainer (fig. 57).

(c) Pour out the contents of the bowl and clean the strainer in SOLVENT, dry-cleaning, making sure that all foreign matter has been removed from the screen. If compressed air is available, blow through the strainer to complete the cleaning operation. Wipe out the bowl with a clean rag.

(d) Place the strainer in position, making sure that the end of the pickup pipe in the center of the bowl cover has entered the center hole in the strainer. Place a new gasket on the under side of the bowl cover with the gasket under the strainer.

(e) Place the bowl in position with its upper rim against the gasket and swing the yoke and clamp nut under the bowl. Tighten the nut securely with the fingers.

(f) Operate the fuel pump hand lever to fill the bowl. This can be determined by disconnecting the carburetor pipe at the carburetor and as the pumping continues, gasoline will not flow from the end of the carburetor pipe until the bowl and supply pipe are full.

d. Carburetor Screen.

(1) To clean the carburetor bowl screen located at the rear of the carburetor below the fuel inlet pipe from the fuel pump, proceed as follows:

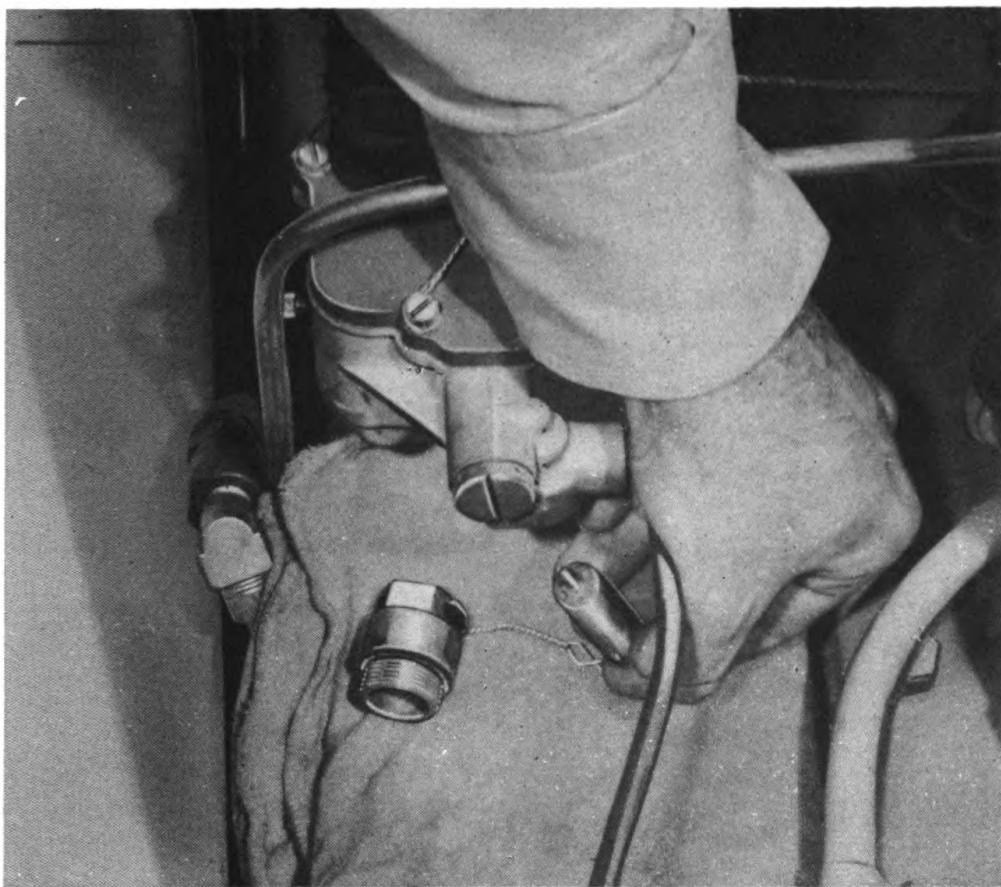
(a) Remove the lock wire in the screen plug (pliers) and remove the hex-head plug and gasket by turning it clockwise ($\frac{7}{8}$ -in. open-end wrench).

(b) Carefully remove the bowl screen by loosening it with a $\frac{1}{2}$ -inch open-end wrench applied at the bottom of the screen and turning the wrench clockwise. Complete the screen removal operation by turning it by hand and remove it from the carburetor (fig. 58).

(c) Clean the bowl screen by immersing it in SOLVENT, dry-cleaning, and blowing around it with compressed air.

(d) Reverse the removal procedure to install the screen, using a new gasket on the screen plug if necessary. Install a new lock wire through the screen plug and float needle valve passage plug at the rear of the carburetor.

FUEL SYSTEM



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Figure 58—Carburetor Screen Removal**70. FUEL PUMP (fig. 59).****a. Equipment.****EXTENSION, socket****WRENCH, open-end, $\frac{3}{8}$ -in.****HANDLE, ratchet****WRENCH, open-end, $\frac{7}{16}$ -in.****SOCKET, $\frac{1}{2}$ -in.****WRENCH, open-end, $\frac{1}{2}$ -in.****b. Removal.**

(1) Remove the engine as outlined in paragraph 55 a.

(2) Disconnect the tank to fuel pump pipe at the fuel pump inlet fitting ($\frac{1}{2}$ -in. open-end wrench).(3) Disconnect the fuel pump outlet pipe at the outlet fitting ($\frac{7}{16}$ -in. open-end wrench).(4) Disconnect the primer inlet pipe at the fuel pump ($\frac{3}{8}$ -in. open-end wrench) and the diluter inlet pipe at the pump ($\frac{1}{2}$ -in. open-end wrench). Remove the 2 cap screws holding the fuel pump to the side of the cylinder block ($\frac{1}{2}$ -in. socket, extension and ratchet handle for rear screw and $\frac{1}{2}$ -in. open-end wrench for front screw) and remove the fuel pump.

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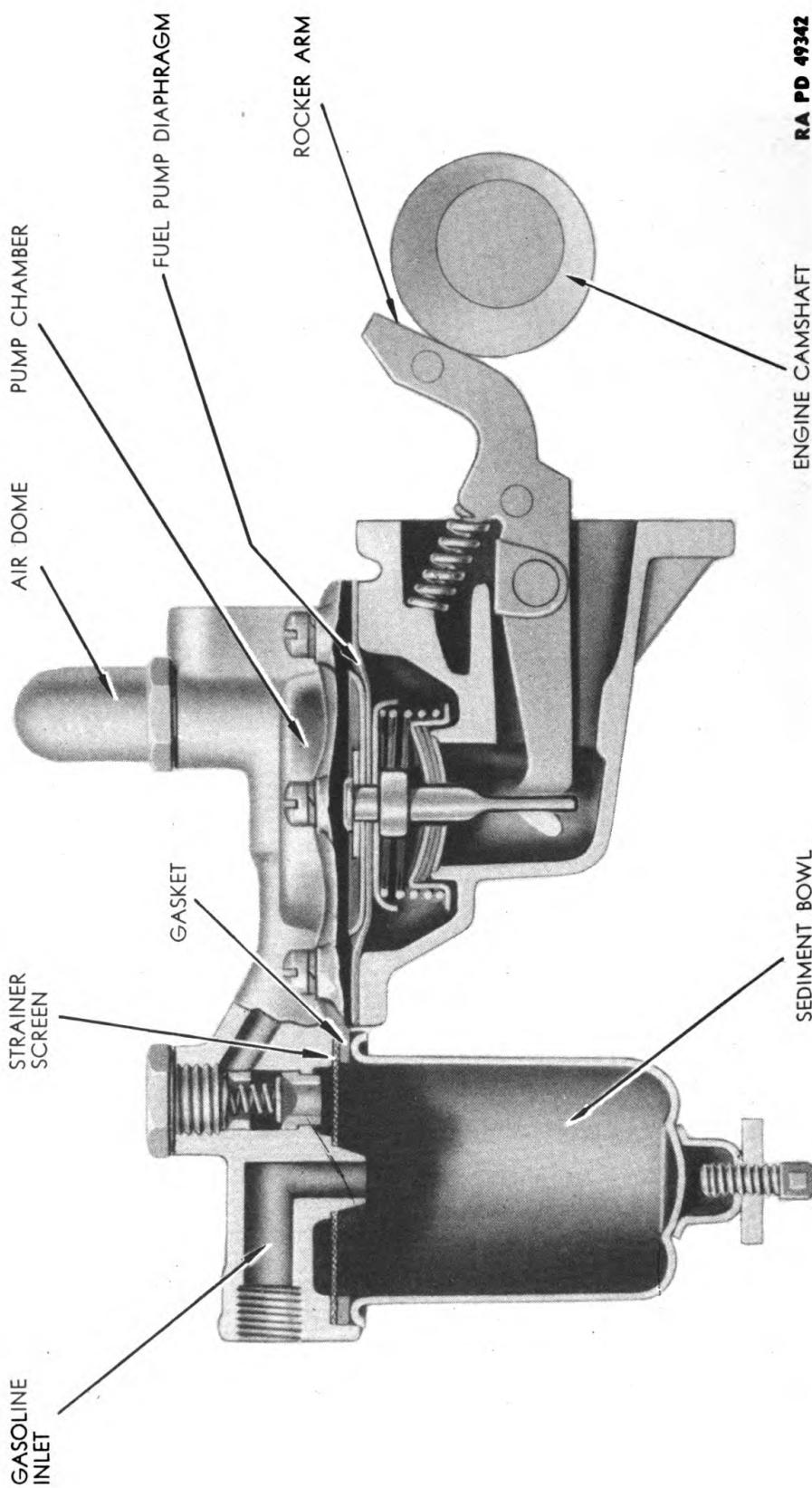


Figure 59—Fuel Pump Cross Section

FUEL SYSTEM

c. Installation. Tools as listed in paragraph 70 a.

(1) If the fuel pump is to be replaced, change the fittings from the old pump to the replacement unit and reverse the removal instructions to install the pump. When installing the pump on the engine, the pump operating arm must be installed to contact the actuating cam on its top side. Replace the gasket, using GREASE, general purpose, to keep the new gasket in place.

(2) After installing the engine, start the engine and check for fuel leaks at the pipe connections.

71. PRIMER.

a. Equipment.

WRENCH, crescent, adjustable

WRENCH, open-end, $\frac{3}{8}$ -in. (2)

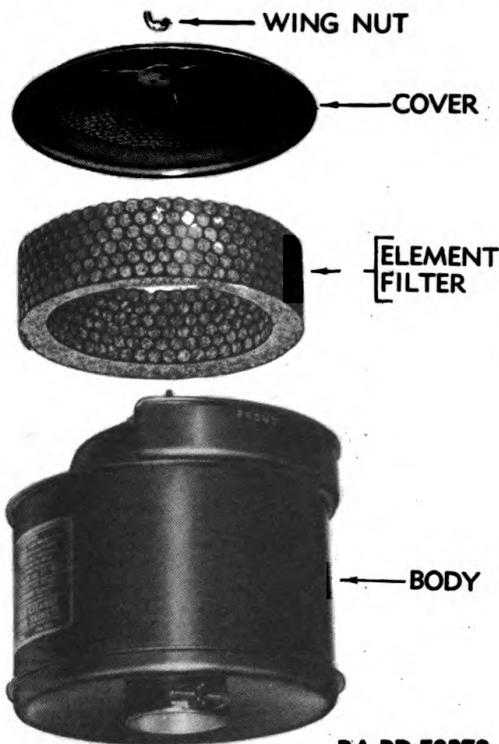
WRENCH, open-end, $\frac{7}{16}$ -in.

WRENCH, open-end, 1-in.

b. Removal.

(1) Disconnect the inlet pipe coupling nut at the primer ($\frac{3}{8}$ -in. and $\frac{7}{16}$ -in. open-end wrenches) and the outlet pipe jam nut ($\frac{3}{8}$ -in. open-end wrenches (2)).

(2) Remove the primer operating button at the face of the instrument panel by turning it counterclockwise while holding the pump shaft on the flats (small adjustable crescent wrench). Loosen the lock nut (1-in. open-end wrench) behind the panel face and turn off the



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Figure 60—Carburetor Air Cleaner Parts

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escutcheon nut on the face of the panel. Slip the primer out of the panel hole.

(3) If it is necessary to remove the primer pipes, the procedure to follow will depend on the pipe or pipes to be taken out; however, no special instructions are needed.

c. **Installation.** Tools as listed in paragraph 71 a.

(1) Reverse the steps given for removal when installing the primer, making certain that all couplings are tight and no leakage exists. A very slight leak in the system will render the primer ineffective.

72. CARBURETOR AIR CLEANER.

a. **Maintenance.** The carburetor air cleaner filters the air entering the carburetor throat; thus for consistent top engine performance the filter element must be serviced as outlined in section V.

b. **Removal.** Whether removing the entire cleaner assembly or just the cover and filter element, it is necessary, first, to remove the engine compartment front lid screen. To remove the screen, the cleaner filter, or the cleaner assembly proceed as follows:

(1) Open the engine compartment front lid and screw off the left- and right-hand wheels to disengage the lid supports and permit the cover to be opened as far as possible.

(2) On the 3 screen support brackets at the top of the bulkhead, hold the nut below each bracket ($\frac{3}{8}$ -in. open-end wrench) while turning the screw (screwdriver) extending through the screen. NOTE: Lock and flat washers are used between the nut and underside of the bracket; in addition, a double star washer is used between the top side of the bracket and the screen. It is important that these parts be installed in exactly the same way so that a good electrical ground is obtained between the screen and vehicle.

(3) Repeat step (2) at the 3 screen support brackets located on the engine compartment lid hinge cross support.

(4) Lift the screen off the brackets and out of the way.

(5) Open the engine compartment lid and with the fingers, remove the wing nut at the top of the cleaner. Lift off the air cleaner cover and filter element. If desired, the entire cleaner assembly may first be removed by loosening the clamp screw (screwdriver) located at the base or throat of the cleaner. With the clamp screw loosened, the cleaner can be lifted off the elbow leading to the carburetor (fig. 60).

c. **Installation.** Reverse the steps followed for removal of the unit and parts as covered in paragraph 72 b, making sure the cleaner base clamp screw, cover wing nut, and engine compartment front lid screen screws are tightened securely.

Section XV

COOLING SYSTEM

	Paragraph
Description	73
Fan and pulley assembly	74
Engine thermostat	75
Radiator	76
Water pump	77
Battery heater	78

73. DESCRIPTION.

a. The liquid type cooling system of this vehicle consists of the radiator, fan, pump, thermostat, and engine water jacket. The warm coolant circulating in the system during engine operation is utilized in heating the battery. The battery heater located at the bottom of the battery compartment consists of a coil through which water from the cylinder head flows before returning to the water pump when the control valve on the inlet side of the water pump is open.

b. With the cooling system full, all of the parts of the system stand full of fluid. When the engine is started the cooling system pump is likewise started, and circulation is set up only within the water jacket of the engine because the engine water thermostatic valve, closed at temperatures below 172 F, blocks the return of the fluid to the upper tank of the radiator. Circulation of the water within the engine continues only until the cooling fluid absorbs enough heat from the engine to become warmer than the rate of the thermostat. When this operating condition is reached the thermostatic valve will open. When the valve has opened fully the cooling fluid flows unrestrictedly into the radiator upper tank and down through the radiator tubes for the cooling fins to dissipate the heat and maintain normal coolant temperature of 175 F.

c. Since the fluid carrying tube for the battery heater is connected to the water pump and cylinder head, the heater functions before the engine water thermostatic valve opens and before all of the coolant has become heated provided the control valve on the inlet side of the pump is open.

d. The capacity of the complete cooling system is 10½ U. S. quarts —8¾ Imperial quarts.

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ANTIFREEZE SOLUTION CHART

	+20 F	+10 F	0 F	-10 F	-20 F	-30 F	-40 F	-50 F
ETHYLENE GLY-								
COL (Prestone)								
U. S. qt	2	2	3.5	4	4.5	5	6	6.5
Imp. qt	1.66	2.5	2.91	3.38	3.75	4.14	5	5.4
ALCOHOL,								
denatured								
U. S. qt	2	3	4	4.5	5	6	6.5	7.5
Imp. qt	1.66	2.5	3.38	3.75	4.14	5	5.4	6.25

74. FAN AND PULLEY ASSEMBLY.

a. Equipment.

HANDLE, ratchet

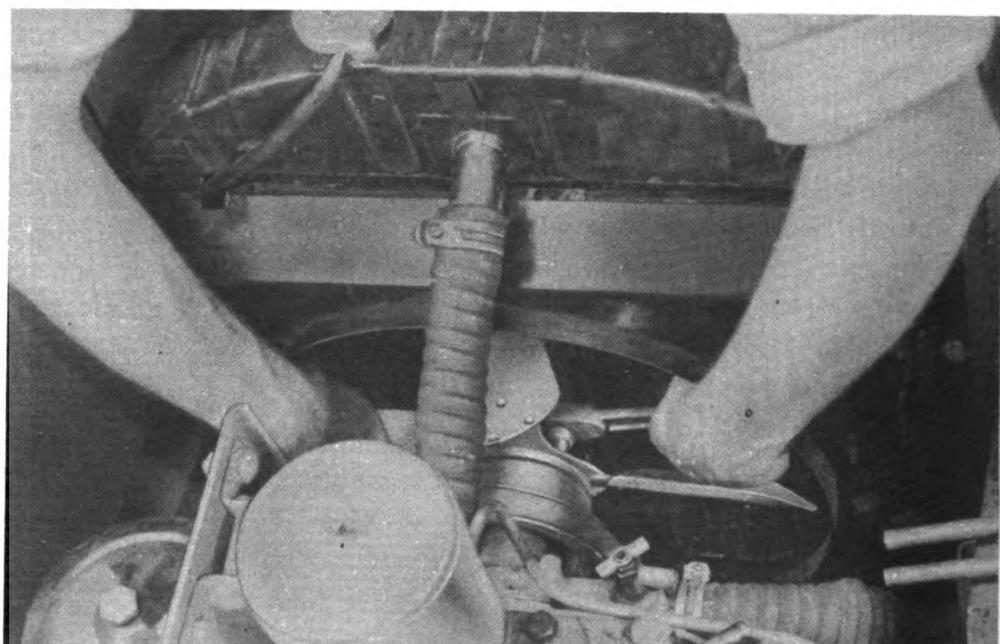
SOCKET, $\frac{1}{2}$ -in.

b. Removal. Raise the engine compartment lid to its fully opened position. Relieve the tension on the fan belt at the generator (c of this page). Remove the 4 cap screws ($\frac{1}{2}$ -in. socket, and ratchet handle) which hold the fan and fan pulley to the water pump shaft hub. Remove the fan and pulley assembly (fig. 61).

c. Installation. Tools as listed in paragraph 74 a, also the following:

WRENCH, box, $\frac{1}{2}$ -in.

WRENCH, open-end, $\frac{1}{2}$ -in.



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Figure 61—Fan and Pulley Assembly Removal

COOLING SYSTEM

When installing the fan and pulley assembly, it may be necessary to relieve the belt tension an additional amount before the fan and pulley cap screws can be started (1/2-in. socket and ratchet handle). The belt tension is relieved by loosening the generator hinge bolts beneath the generator (1/2-in. box and open-end wrenches). Then loosen the generator adjusting arm pivot screw (1/2-in. open-end wrench). Push the generator up toward the engine to loosen the belt. When the fan and pulley are installed, swing the generator out (downward) away from the engine to tighten the belt until there is a belt deflection of 3/4 inch, midway between the generator and the fan pulley. Tighten the adjusting arm clamp screw, the adjusting arm pivot screw, and the generator hinge bolts. Make sure the fan screws are tightened securely. Using the vehicle hand crank, turn the engine at least one complete revolution to make sure the fan does not strike the shroud at any point, and close the engine compartment lid.

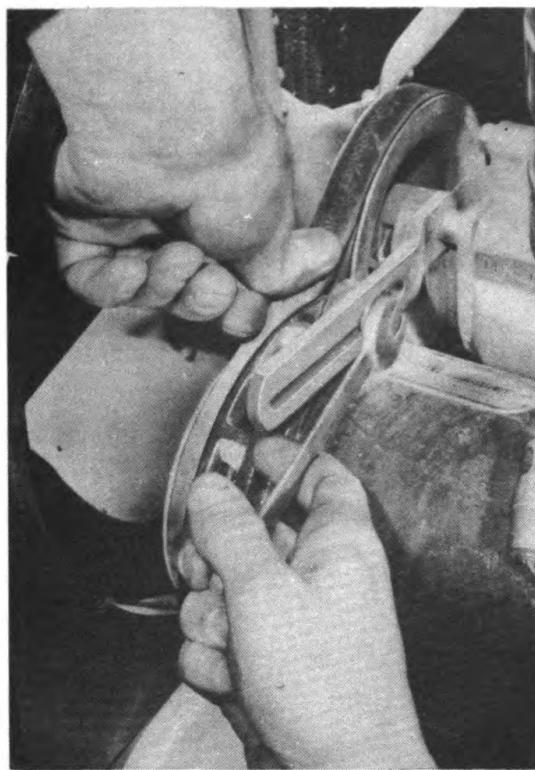
d. Belt Adjustment.

WRENCH, box, 1/2-in.

WRENCH, open-end, 1/2-in.

(1) Raise the engine compartment lid.

(2) Push in on the belt, midway between the generator and the fan.



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Figure 62—Fan Belt Adjustment

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If the belt has more or less than $\frac{3}{4}$ -inch deflection at this point, the belt should be adjusted. A belt that is too tight will work a hardship on the generator and water pump bearings while a belt that is too loose will very likely slip and cause overheating and undercharging of the battery.

(3) Loosen the generator hinge bolts ($\frac{1}{2}$ -in. box and $\frac{1}{2}$ -in. open-end wrenches), loosen the adjusting arm clamp screw ($\frac{1}{2}$ -in. open-end wrench), and loosen the adjusting arm pivot stud nut ($\frac{1}{2}$ -in. open-end wrench). Pry the generator upward to loosen the belt or downward to tighten. The belt should have a deflection of $\frac{3}{4}$ inch midway between the generator and the fan pulley (fig. 62).

(4) Tighten the generator adjusting arm clamp screw while holding the generator in position for correct belt tension.

(5) Tighten the generator hinge bolts and the adjusting arm pivot stud nut securely.

e. Belt Removal.

WRENCH, box, $\frac{1}{2}$ -in.

WRENCH, open-end, $\frac{1}{2}$ -in.

(1) Loosen the generator as outlined in paragraph 74 e.

(2) Remove the belt from the generator and fan pulleys and, after twisting the belt at the bottom, force the belt out between the fan drive (crankshaft) pulley and hull cross member. Work the belt out over the fan blades and between the blades and shroud.

f. Belt Installation.

(1) Reverse the procedure outlined for removal to install a new belt.

(2) Adjust the fan belt tension as outlined in paragraph 74 e and complete the operation.

75. ENGINE THERMOSTAT.

a. Equipment.

HANDLE, flexible

SOCKET, $1\frac{1}{16}$ -in.

SCREWDRIVER

b. Removal.

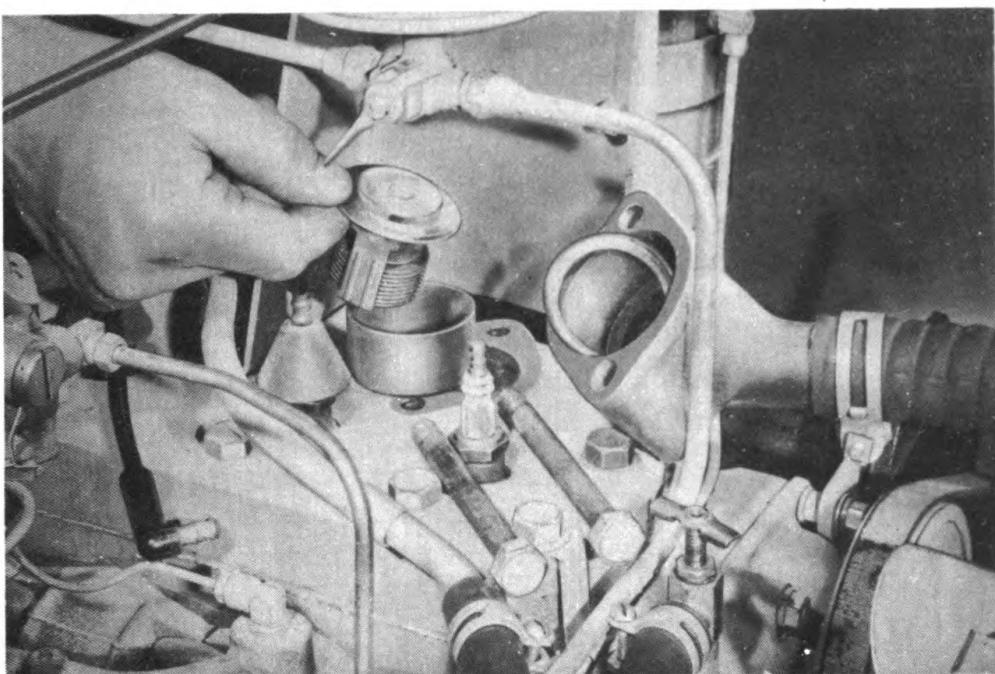
(1) Drain the cooling system as outlined in paragraph 76. Loosen the hose clamps (screwdriver) and remove the cylinder head to radiator hose.

(2) Turn the diluter valve handle toward the front and remove the 2 water outlet elbow cap screws ($1\frac{1}{16}$ -in. socket and flex. handle) and take off the water outlet elbow.

(3) Remove the water outlet elbow flange gasket and the thermostat sleeve gasket. On reassembly, fit new gaskets to the flange and sleeve bore, using GREASE, general purpose, to keep the gaskets in place.

(4) LIFT OFF THE SLEEVE AND THERMOSTAT (fig. 63). NOTE: The coils of the thermostat are downward. The thermostat must be installed

COOLING SYSTEM



RA PD 49400

Figure 63—Engine Thermostat Removal

in this position without fail; otherwise, the valve action will be rendered entirely useless and overheating will result.

c. Maintenance and Test. If the operation of the thermostat is known to be faulty, the unit should be replaced. No attempt should be made to repair a thermostat. To test the unit, immerse it in water which has been heated to the rated opening temperature (172 F) of the thermostat valve. If the valve does not start to open or if it sticks in the fully open position, replace the thermostat.

d. Installation. Tools as listed in paragraph 75 a.

When installing the thermostat, make sure the small breather hole is open. In other respects, installation is the reverse of the removal procedure as in b described above. Make sure the diluter valve handle is turned so it points downward, so that the diluter will not operate when the engine is started. After completing the operation, make sure no leaks exist at the hose or outlet gasket and that the thermostat is functioning normally by testing its action with the engine running.

76. RADIATOR.

a. Equipment.

EXTENSION, socket

HANDLE, ratchet

PAN, drain

PAPER

SCREWDRIVER

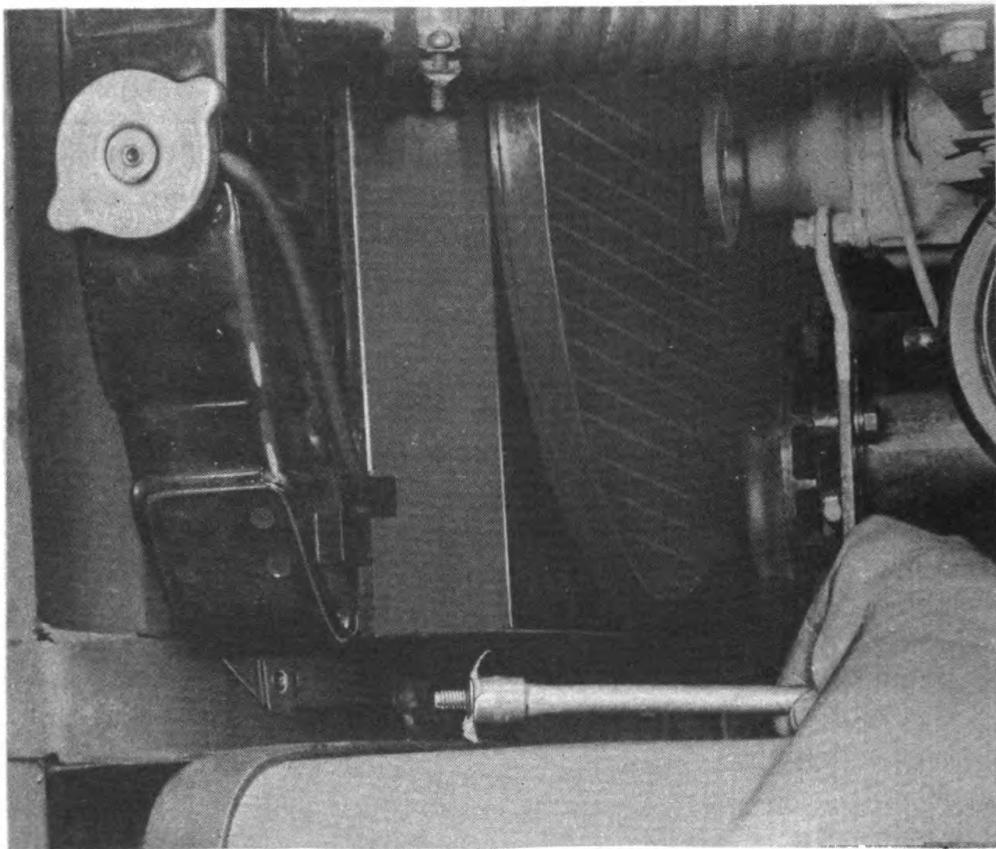
SOCKET, 1/2-in. Original from

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b. Removal.

- (1) Raise the engine compartment lid to the fully opened position and turn the sealing radiator cap to its half-open position.
- (2) Remove the cooling system drain plug (screwdriver) located on the bottom of the hull just ahead of the crankcase drain hull plate.
- (3) Open the radiator drain valve at the radiator outlet pipe in the lower left rear section of the engine compartment and allow the cooling system to drain (drain pan). If antifreeze is in use, save the solution. When the cooling system has drained, close the radiator drain valve securely and install the drain plug in the hull using LEAD, white, basic-carbonate, on the screw to obtain a positive seal at this point.
- (4) Loosen the radiator hose connections (screwdriver) at the upper radiator inlet pipe and at the water pump. Pull the hose connections off the upper pipe and water pump inlet pipe. Loosen the battery heater hose clamps (screwdriver) at the heater coil end and pull the heater inlet and outlet hoses off the coil.
- (5) Pull off the cylinder block drain hose at the drain valve in the lower radiator pipe.



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COOLING SYSTEM

(6) Remove the fan and pulley assembly as outlined in paragraph 74 b.

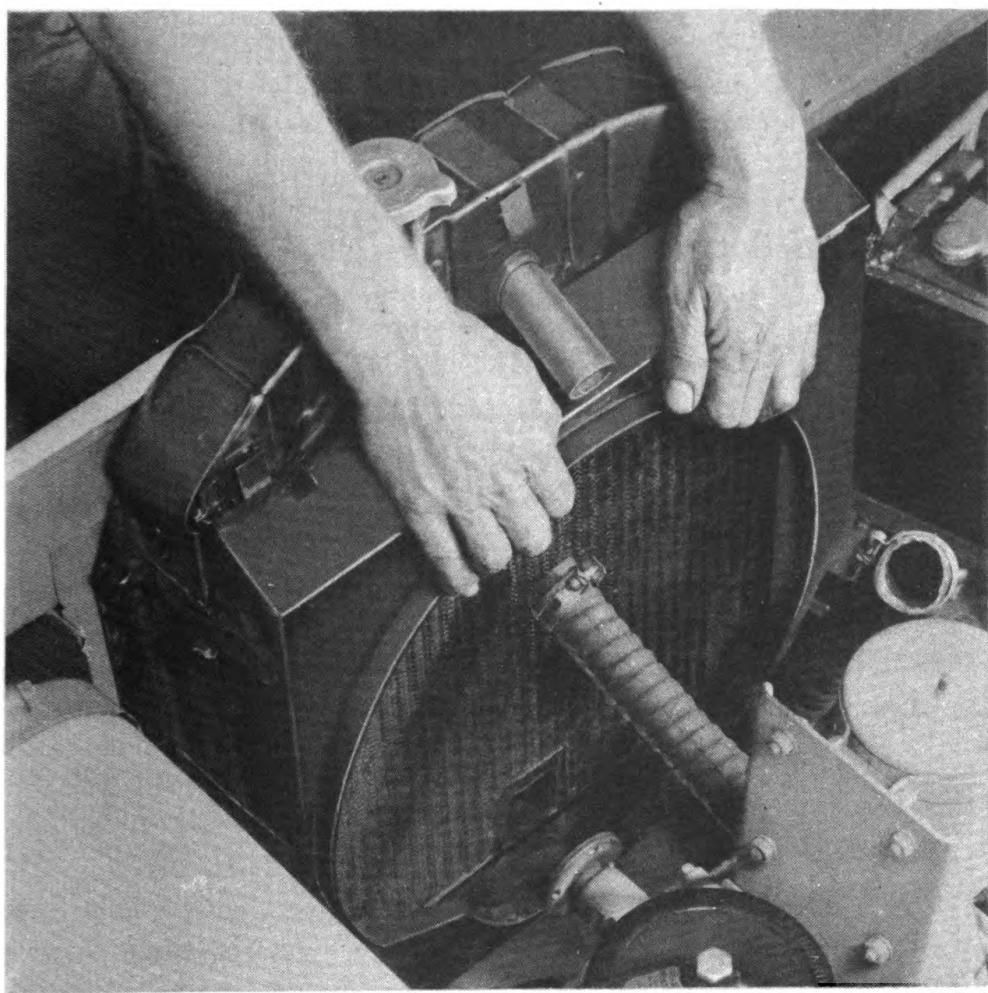
(7) Using a $\frac{1}{2}$ -inch socket extension, ratchet handle, and paper within the socket to retain the screws when loose, remove the 3 metal screws on each side which hold the radiator flanges to the hull (fig. 64). Lift the radiator and shroud out of the engine compartment (fig. 65).

(8) If the radiator is to be repaired or replaced, remove the fan shroud.

c. **Maintenance.** The radiator requires no special services. The 6 screws holding the radiator to the hull at the left and right radiator flanges should be kept tight. When leakage from the radiator core is detected, a replacement core should be installed or a full report on the condition should be directed to the ordnance personnel.

d. **Installation.** Tools as listed in paragraph 76 a, also the following:

LEAD, white, basic-carbonate PUNCH, tapered drift (2)



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(1) When installing the radiator, the flange holes may be held in alignment with the holes in the hull through the use of 2 short tapered drift punches inserted in the right and left upper holes while the lower screws are installed. The remainder of the installation is completed by reversing the removal instructions. Use LEAD, white, basic-carbonate, on the hose connections and test for leaks with the engine running. When filling the cooling system, it will be found that as much as a gallon of coolant can be added after the engine has operated long enough to open the thermostat and bleed off the air trapped in the cooling system pockets, heater, etc.

77. WATER PUMP.

a. Equipment.

HANDLE, ratchet

SOCKET, $\frac{1}{2}$ -in.

PAN, drain

WRENCH, box, $\frac{1}{2}$ -in.

SCREWDRIVER

b. Removal.

(1) Raise the engine compartment lid to its fully opened position.

(2) Relieve the tension on the fan belt as outlined in paragraph 74 c and remove the generator adjusting arm. Remove the fan and pulley assembly as outlined in paragraph 74 a.

(3) Turn the radiator cap to the half-open position to unseal the cooling system. Remove the cooling system drain plug (screwdriver) on the bottom of the hull just ahead of the oil pan drain plug hull plate. Open the radiator drain valve at the end of the lower radiator pipe and allow the system to drain (drain pan). Then shut off the valve and reinstall the cooling system drain plug in the hull using LEAD, white, basic-carbonate, on the screw to obtain a positive seal. If antifreeze is in use, save the solution.

(4) Loosen the clamp screws (screwdriver) and pull off the hose connections from the water pump.

(5) Remove the 3 cap screws ($\frac{1}{2}$ -in. box wrench) holding the water pump to the cylinder block.

(6) Remove the water pump assembly and gasket.

c. Maintenance. The water pump shaft is supported by prelubricated ball bearings, thus no lubrication is required at this unit. A nonadjustable type packing is used. When leakage develops, the pump should be replaced.

d. Installation. Tools as listed in paragraph 77 a, also the following:
TESTER, antifreeze, EDL116

(1) When installing the water pump make sure the shaft is free and that there is no scraping sound when the pulley hub is rotated by hand.

COOLING SYSTEM

(2) Use a new gasket and install the water pump, applying **GREASE**, general purpose, to the gasket to hold it in place.

(3) Coat the 3 cap screws with **LEAD**, white, basic-carbonate, and install and tighten them evenly and securely (1/2-in. box wrench).

(4) Reverse the removal procedure to complete the operation.

(5) Fill the cooling system and if antifreeze is in use, test the strength of the solution with **TESTER**, antifreeze, EDL116, adding new solution as required (fig. 66). Operate the engine and check for leaks.

NOTE: When filling the cooling system it will be found that considerable extra fluid can be added after the thermostat has opened and the trapped air has been bled out of the system through the upper radiator tank. After the thermostat opens and after the gurgling sound and bubbling stops, be sure to add additional fluid as required to entirely fill the cooling system. Then close the radiator filler cap completely to shut off the overflow and seal the system.

78. BATTERY HEATER.

a. Equipment.

EXTENSION, socket
HANDLE, ratchet
SCREWDRIVER
SOCKET, 1/2-in.

WRENCH, box, 7/16-in.
WRENCH, box, 9/16-in.
WRENCH, open-end, 7/16-in.
WRENCH, open-end, 5/8-in.

b. Removal.

(1) Raise the engine compartment lid, take out the 2 bolts (7/16-in. box and 7/16-in. open-end wrenches) holding the battery cover to the rear deck coaming, and remove the 7 cap screws (1/2-in. socket extension, and ratchet handle) which fasten the battery cover to the left quarter wall, shelf, and left deck coaming. Lift the insulated battery compartment cover upward, to the right, and out of the engine compartment. Disconnect the battery cable clamps (9/16-in. box wrench) and remove the battery holddown frame nuts (5/8-in. open-end wrench) to lift off the frame. Lift the battery out of the compartment.

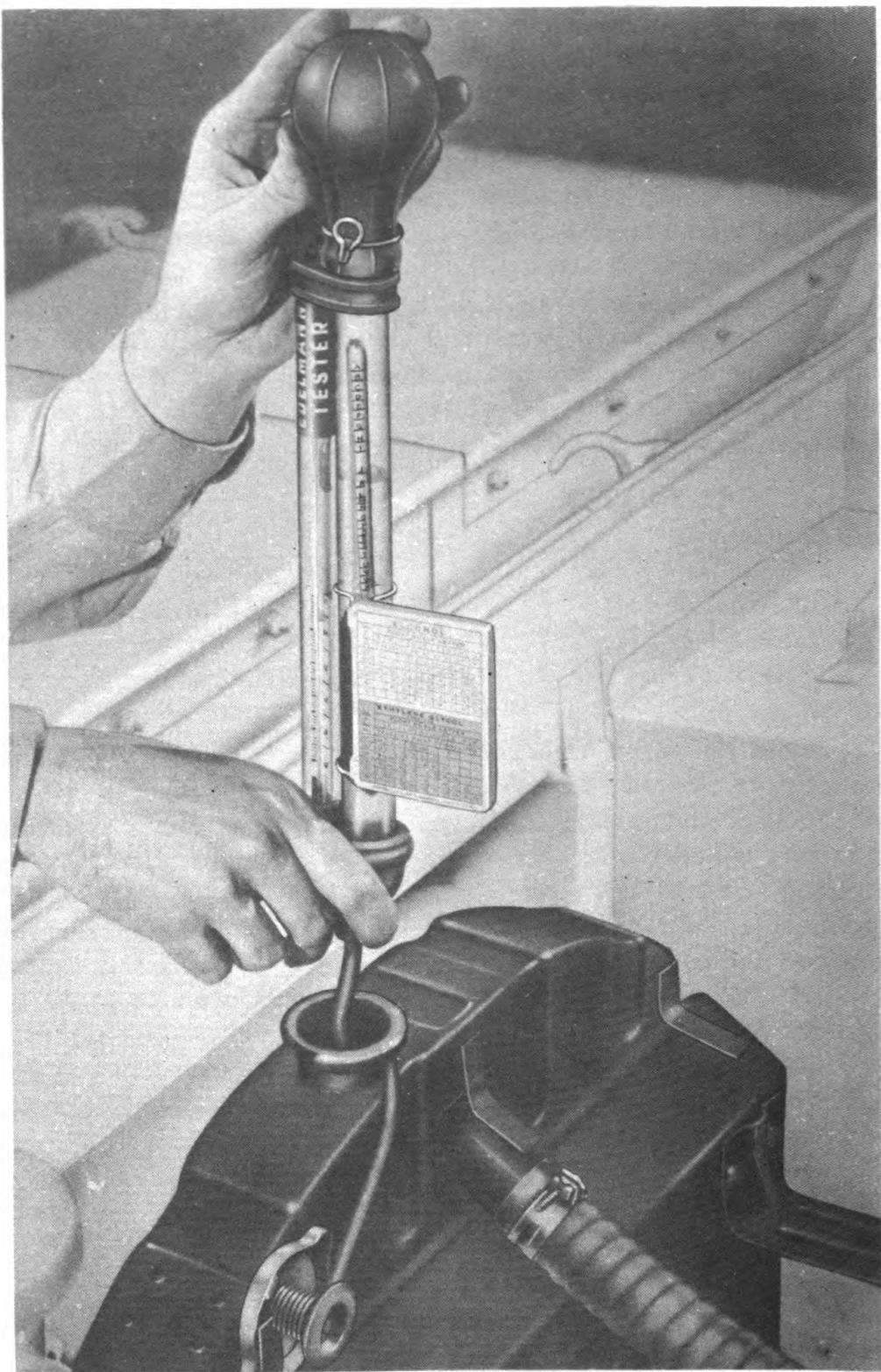
(2) Drain the cooling system as outlined in paragraph 76 a (2) and (3), disconnect the battery heater hose clamps (screwdriver), and pull off the hoses from the heater coil.

(3) Remove the 3 screws (screwdriver) which secure the coil through threaded clips to the battery base support frame. Remove the battery heater from the bottom of the battery compartment.

c. Installation. Tools as listed in paragraph 78 a.

Reverse the removal procedure to install the battery heater using **LEAD**, white, basic-carbonate, on the hose connections and testing for leaks with the engine running. Also, determine if the cooling fluid is circulating in the heater coil. The coil should become warm within 5 minutes after starting the engine.

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Figure 66—Checking Antifreeze Solution Tester EDL-116

Section XVI

CLUTCH

	Paragraph
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Lubrication	80
Control linkage adjustment	81
Clutch replacement	82
Clutch housing alinement	83
Engine flywheel	84

79. GENERAL DESCRIPTION.

a. The single-plate, dry, disk-type clutch is located immediately ahead of the engine flywheel within a housing behind the assistant driver's seat and on the cockpit side of the bulkhead. The bell shaped clutch housing is bolted securely to the engine front plate and encloses the clutch with release mechanism and the flywheel. The clutch release bearing operating on the transmission pinion flange is of the ball type and is prelubricated. The clutch itself cannot be adjusted to compensate for wear.

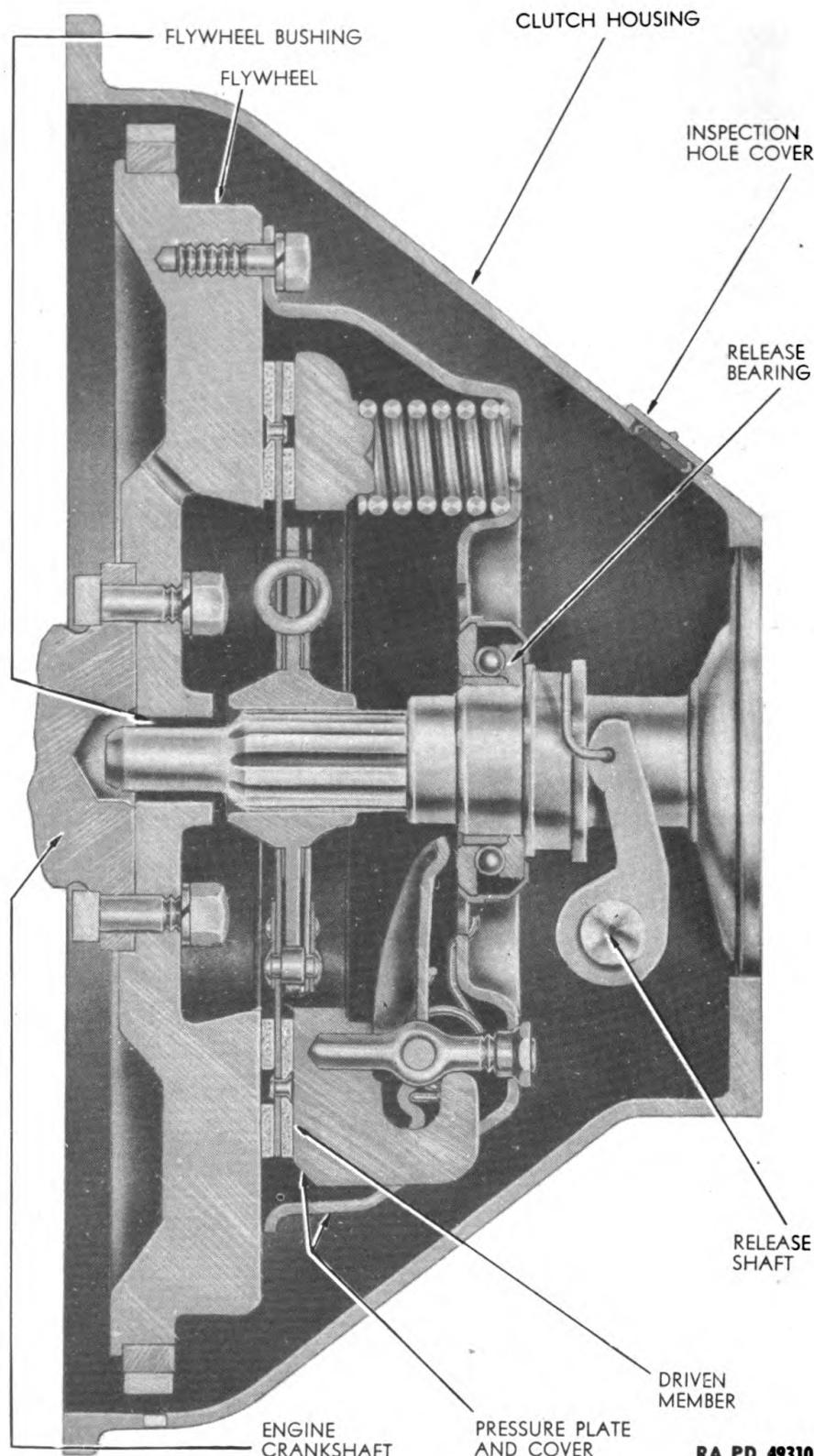
b. The clutch is operated by depressing and releasing a pedal at the driver's left foot. The pedal is connected to a release shaft at the clutch housing by a flexible cable; the effective length of the cable is adjustable at a clevis linking the cable to the external release lever on the left end of the release shaft.

c. On depressing the clutch pedal, the release bearing moves toward the engine flywheel and contacts the inner ends of 3 release levers which are a part of the pressure plate and cover assembly. Six bolts secure the pressure plate and cover assembly to the engine flywheel. The force on the lever ends cause the pressure plate to move ahead and compress the 6 coil springs in the plate and cover assembly. This action disconnects the drive by releasing the pressure of the pressure plate against the forward face of the driven member and the pressure of the rear face of the driven member against the engine flywheel (fig. 67).

80. LUBRICATION.

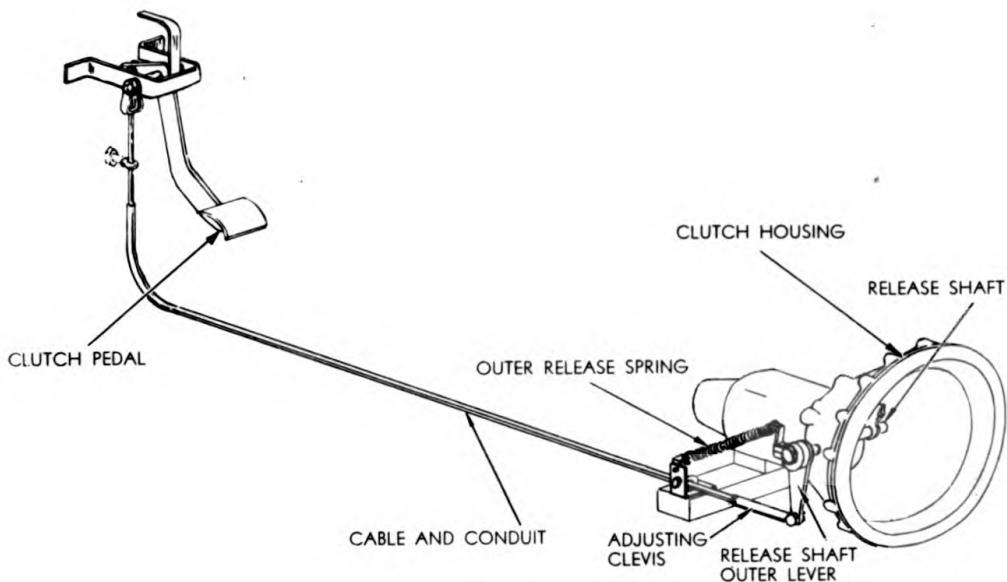
a. An oiler is provided at the right end of the clutch release shaft for lubrication at the shaft bushing. Engine oil must be applied at this point and at the cable clevis in accordance with the directions given in section V. The clutch release bearing is packed at assembly with high melting point lubricant and does not require supplementary lubrication during the life of the bearing. The clutch pilot bushing located in the flywheel hub and supporting the rearward end of the transmission pinion

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RA PD 49310

CLUTCH



RA PD 49298

Figure 68—Clutch Release Linkage

shaft is coated with lubricant at assembly. This bushing requires lubrication only when operations involving removal of the transmission are performed.

81. CONTROL LINKAGE ADJUSTMENT (fig. 68).**a. Equipment.**

PLIERS

WRENCH, open-end, $\frac{9}{16}$ -in.WRENCH, open-end, $\frac{1}{2}$ -in.

To make certain that the clutch releases and engages completely, it is important to have at least 1 inch of free travel of the pedal before the clutch starts to disengage. This clearance is maintained by adjustment of the control linkage connecting the clutch pedal to the clutch release shaft external lever.

b. Procedure.

(1) Loosen the pedal stop screw ($\frac{1}{2}$ -in. open-end wrench) and turn the adjusting screw in (clockwise) until it bottoms on the lock nut.

(2) Take out the release cable clevis cotter pin and remove the pin (pliers) joining the cable to the release shaft external lever at the lower left side of the clutch housing.

(3) Loosen the clevis lock nut ($\frac{9}{16}$ -in. open-end wrench) and turn the clevis clockwise to shorten the effective length of the cable or counter-clockwise to lengthen the cable until no slack or pull exists on the clutch release shaft lever when the clevis eye is in line with the lever hole.

(4) Insert the clevis pin, tighten the clevis lock nut, and install a new cotter pin.

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(5) Returning to the clutch pedal at the front of the cockpit, back off the pedal stop screw (by turning counterclockwise) until 1 inch of free pedal movement is present before clutch disengagement starts.

(6) Tighten the stop screw lock nut.

82. CLUTCH REPLACEMENT.

a. Equipment.

BOLT, eye, engine lifting,	SOCKET, $\frac{7}{16}$ -in.
HKM-J53	SOCKET, $\frac{1}{2}$ -in.
CHAIN, lifting	SOCKET, $\frac{9}{16}$ -in.
EXTENSION, socket	SOCKET, $\frac{5}{8}$ -in.
HAMMER	WRENCH, box, $\frac{9}{16}$ -in.
HANDLE, ratchet	WRENCH, open-end, $\frac{3}{8}$ -in.
HANDLE, speeder	WRENCH, open-end, $\frac{7}{16}$ -in.
HOIST	WRENCH, open-end, $\frac{1}{2}$ -in.
PLIERS	WRENCH, open-end, $\frac{9}{16}$ -in.
SCREWDRIVER	WRENCH, open-end, $\frac{5}{8}$ -in.

b. Removal.

(1) Remove the transmission by following the procedure outlined in paragraph 89 b.

(2) Disconnect the battery ground strap, following the directions given in paragraph 55 a (8).

(3) Remove the bulkhead in accordance with the steps outlined in paragraph 55 a (11).

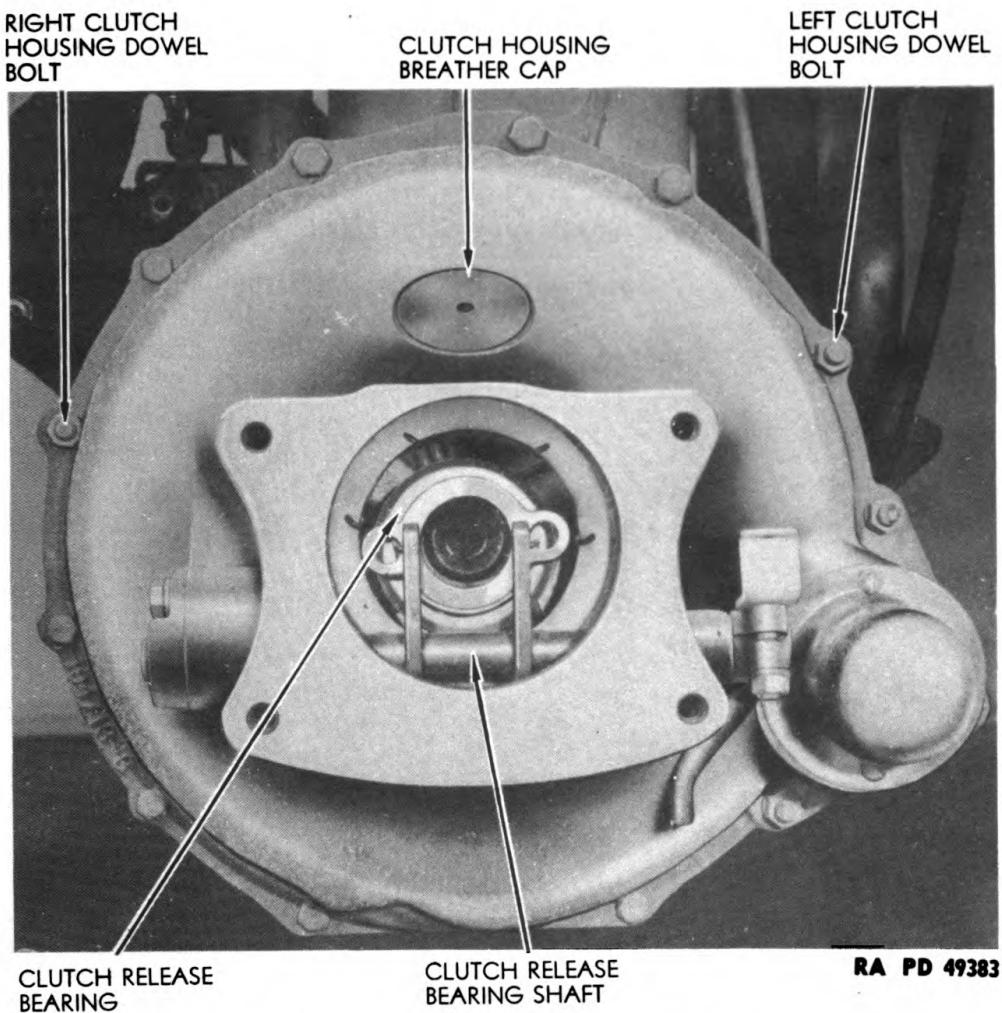
(4) Disconnect the starter motor cable ($\frac{9}{16}$ -in. open-end wrench) and remove the 3 clutch housing bolts with nuts and locks ($\frac{9}{16}$ -in. socket extension, ratchet handle, and $\frac{9}{16}$ -in. open-end wrench) which secure the starter to the engine front plate and clutch housing. Move the starter motor with Bendix drive rearward away from the engine flywheel.

(5) Remove the 2 clutch housing dowel bolt nuts ($\frac{1}{2}$ -in. socket and ratchet handle) on the front side and, with a hammer, tap the dowel bolts rearward out of the engine front plate. The dowel bolts are located at the two points where the prominent ears of the clutch housing may be observed. On the left side it is the first bolt above the starter motor upper bolt, and on the right side it is the second bolt to the right of the right-hand upper cap screw (fig. 69).

(6) Remove the 5 bolts and nuts ($\frac{1}{2}$ -in. socket extension, ratchet handle and $\frac{1}{2}$ -in. open-end wrench) around the right side and bottom of the clutch housing.

(7) Remove the 3 cap screws ($\frac{9}{16}$ -in. socket extension, and ratchet handle) at the top of the clutch housing.

CLUTCH



RA PD 49383

Figure 69—Clutch Release Mechanism

(8) Lift off the clutch housing from the engine front plate.

(9) Loosen, progressively, each of the 6 clutch pressure plate cover to flywheel screws ($\frac{1}{2}$ -in. socket and speeder handle) by turning them only $\frac{1}{2}$ turn at a time to prevent the clutch springs from distorting the flange of the clutch pressure plate. After loosening the screws until all the tension has been relieved, remove them in any order.

(10) Remove the clutch pressure plate assembly and the clutch driven member from the engine flywheel.

c. **Installation.** Tools as listed in paragraph 82 a, also the following:

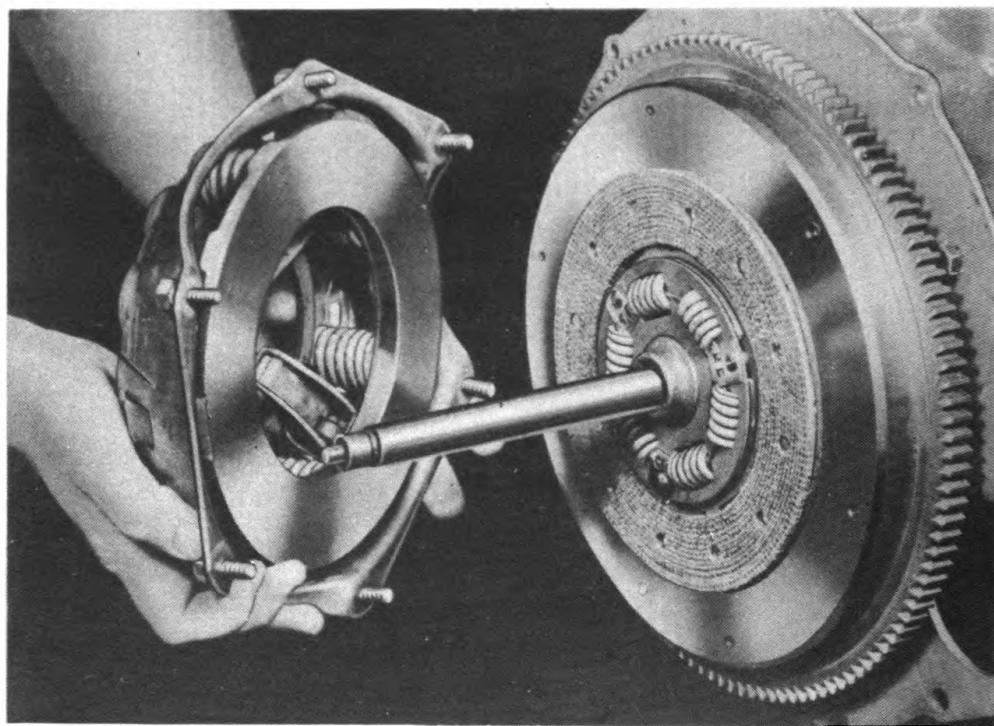
GAGE, clutch alining, MPF6A **HANDLE**, speeder

GREASE

(1) Before assembling the clutch, use **GREASE**, general purpose, to coat the surface of the clutch pilot (transmission pinion) bushing in the flywheel hub. Then install the special clutch alining gage MPF6A with

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its small collet resting in the bore of the pilot bushing. Slide the clutch driven member with the long side of hub away from front of the engine flywheel (fig. 67) over the gage and expand both collets until the arbor is tight and rigid in the bushing and splined driven member hub. In this position, the gage will be at right angles to the flywheel face and the rear disk of the driven member will be flat against the forward face of the engine flywheel (fig. 70).



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Figure 70—Installing Clutch Pressure Plate Assembly with Alining Arbor MP-F6A

(2) Place the pressure plate assembly in position against the forward disk of the driven member and install and tighten the 6 pressure plate flange screws ($\frac{1}{2}$ -in. socket, and speeder handle) until the clutch spring tension is detected. Then complete the progressive tightening of the pressure plate flange screws by turning them only $\frac{1}{2}$ turn at a time to avoid distorting the flange. Make an additional complete round of the 6 screws to make certain the cap screws are tightened securely.

(3) Loosen the knurled nut at the end of the alining gage to allow the collets to retract. Then withdraw the gage, being careful to avoid catching and pulling off any of the collet segments.

(4) Place the clutch housing in position and start one of the upper cap screws to preserve the general alinement.

(5) Move the housing as required to line up the left and right dowel bolt holes and from the rear tap the 2 dowel bolts in place (hammer).

CLUTCH

Install the lock washers and nuts and tighten the nuts securely (1/2-in. socket and ratchet handle). Then install the remaining cap screws (9/16-in. socket extension, and ratchet handle) and bolts with nuts (1/2-in. socket extension, ratchet handle, and 1/2-in. open-end wrench), as well as the starter motor (9/16-in. socket extension, ratchet handle, and 9/16-in. open-end wrench)—tightening the screws and bolt nuts alternately to preserve alignment and avoid distorting the housing.

(6) To complete the installation, reverse the removal steps outlined under paragraph 82 b.

83. CLUTCH HOUSING ALINEMENT.

a. Equipment.

GAGE, clutch alining, MPF6A

SOCKET, 1/2-in.

HAMMER, lead

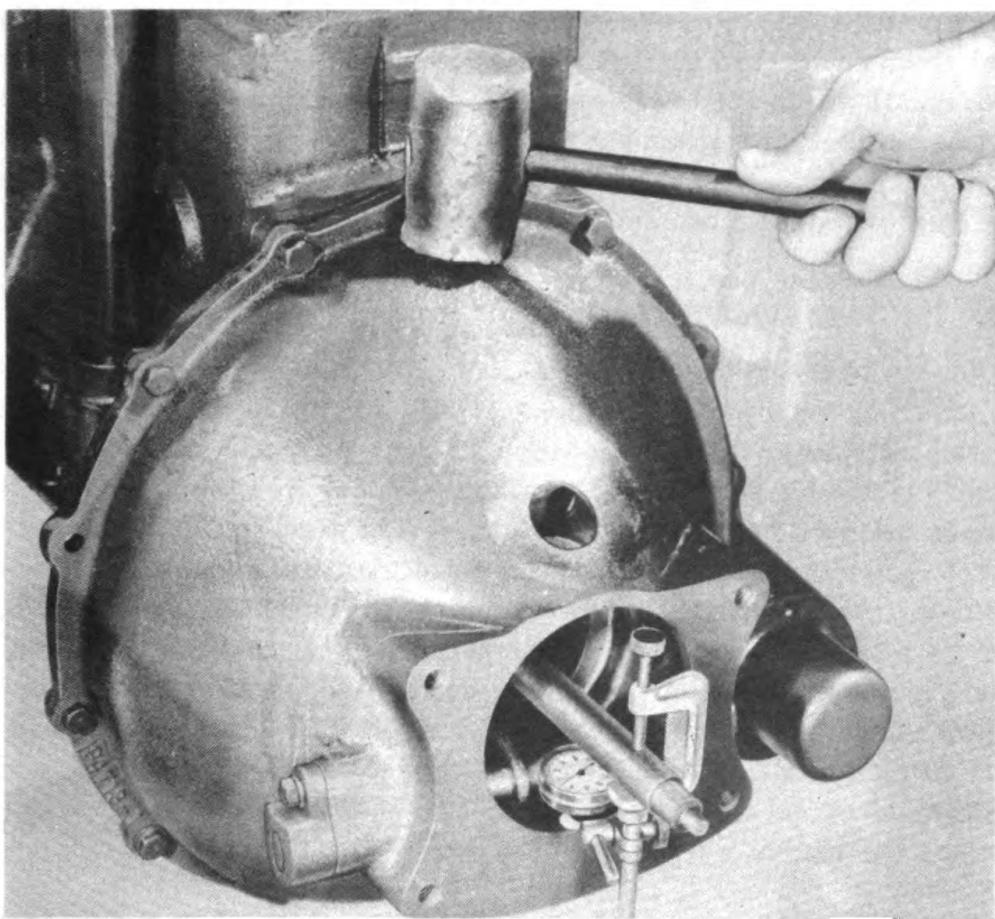
SOCKET, 9/16-in.

HANDLE, ratchet

WRENCH, box, 9/16-in.

INDICATOR, dial test, SBSS196

WRENCH, open-end, 1/2-in.



RA PD 49327

**Figure 71—Alining Clutch Housing Indicator SB-S196
and Gage MP-F6A**

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b. Procedure.

(1) When a new clutch housing is installed, it is necessary to aline the housing with the engine. To do this, first install the housing on the engine front plate, pulling the bolts down snugly but not tight. Then attach dial test indicator SBSS196 onto the clutch *alining gage MPF6A* in place so that the indicator button contacts the forward clutch housing bore. Use a lead hammer to aline the housing within 0.006-inch as registered when taking indicator readings at various points on the housing bore (fig. 71).

(2) With the housing alined, tighten the housing bolts and, if necessary, use a $\frac{3}{8}$ -inch expansion reamer through the engine front plate and alinement holes in the clutch housing. Insert the 2 dowel bolts from the rear side of the engine front plate and install the nuts ($\frac{1}{2}$ -in. socket, and ratchet handle). After tightening the 5 bolts, the 3 screws at the top of the housing, and the 3 bolts holding the starter motor, use the dial test indicator on the alining gage to check the amount of variation at the housing bore face. If readings vary more than 0.006 inch opposite any one of the 4 transmission mounting holes, loosen the housing bolts and screws and then tighten then alternately. If after rechecking, the face is not within the limits specified, and if satisfactory alinement cannot be obtained by tightening the housing bolts, use shims at the 3 low points between the housing bore face and the transmission to obtain the best possible alinement of both units.

84. ENGINE FLYWHEEL.

a. Description.

Although the flywheel is a part of the engine, it is covered in this section because of its close location to the clutch and its related function. The flywheel is attached to a flange on the front end of the engine crankshaft by 6 bolts, nuts, and locks. A ring gear, shrunk onto the rim of the flywheel, serves to revolve the crankshaft for engine starting when meshed with the starter motor pinion gear. The hub of the flywheel carries a bronze bushing which supports the rear end of the transmission pinion shaft. The clutch driven member slides on the transmission pinion shaft splines, and the flywheel hub bushing is usually referred to as the clutch pilot bushing. The transmission pinion shaft (clutch pilot) bushing must be coated with GREASE, general purpose, before re-installing the clutch.

b. Flywheel Removal. Tools as listed in paragraphs 55, 82 and 89.

(1) To obtain access to the flywheel, it is necessary to remove the engine from the vehicle (par. 55), the transmission (par. 89), the clutch housing, and the clutch assembly (par. 82).

CLUTCH

(2) Remove the 6 bolt nuts and locks ($\frac{9}{16}$ -in. socket extension, and ratchet handle) securing the flywheel to the crankshaft flange and lift the flywheel with starter ring gear away from the front of the engine.

c. Installation. Tools as listed in paragraph 84 b.

(1) The flywheel is installed by reversing the removal procedure. The attaching bolt holes in the flywheel are so spaced that it cannot be installed incorrectly with respect to the timing markings stamped on its rear face.

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Section XVII

TRANSMISSION

	Paragraph
General description	85
Lubrication	86
Control linkage adjustment	87
Gearshift rods and levers	88
Transmission	89

85. GENERAL DESCRIPTION.

a. The transmission is of the conventional, automotive, synchronized type having three forward speeds and one reverse. Power enters at the rear end of the transmission through the transmission pinion from the clutch driven member, the hub of which is carried on the pinion shaft splines. The pinion is supported at its front end by a ball bearing and at the rear by a bushing in the flywheel hub. Just inside the rear wall of the transmission case the power is transmitted to the transmission countershaft cluster gear. The cluster is carried on bronze bushings bearing on the countershaft which is locked stationary in the case. The countershaft gear cluster and the transmission pinion are in motion at all times when the engine is operating and the clutch is engaged (fig. 72). A splined mainshaft, a synchronizer unit, and a sliding gear, together with 2 shifting forks, complete the power train of the transmission unit. The mainshaft is borne at its front end by a ball bearing while the rear end turns on a roller bearing recessed in the forward end of the pinion (fig. 73). Movement of the synchronizer or sliding gear is controlled by the transmission remote control shift lever located at the front of the cockpit immediately ahead of the driver's seat. The position of the synchronizer or sliding gear can be changed by moving the control lever and linkage to engage the first speed combination, the second speed gearing, or the reverse gear combination. When the shift to high gear (third speed) is made, the synchronizer moves to the rear to engage the external teeth of the pinion. The drive through the countershaft gears is eliminated entirely in this position because the main shaft is connected directly with the engine clutch. The reverse direction of motion is accomplished through an idler gear engaged with the small gear of the cluster. The forward sliding gear engages with the idler gear when a shift is made into reverse. The idler gear turns on a bronze bushing fitted to its hub.

b. The second and high sliding gear is fitted with synchronizing rings to permit shifting between second and high, or vice versa, without gear tooth interference.

TRANSMISSION

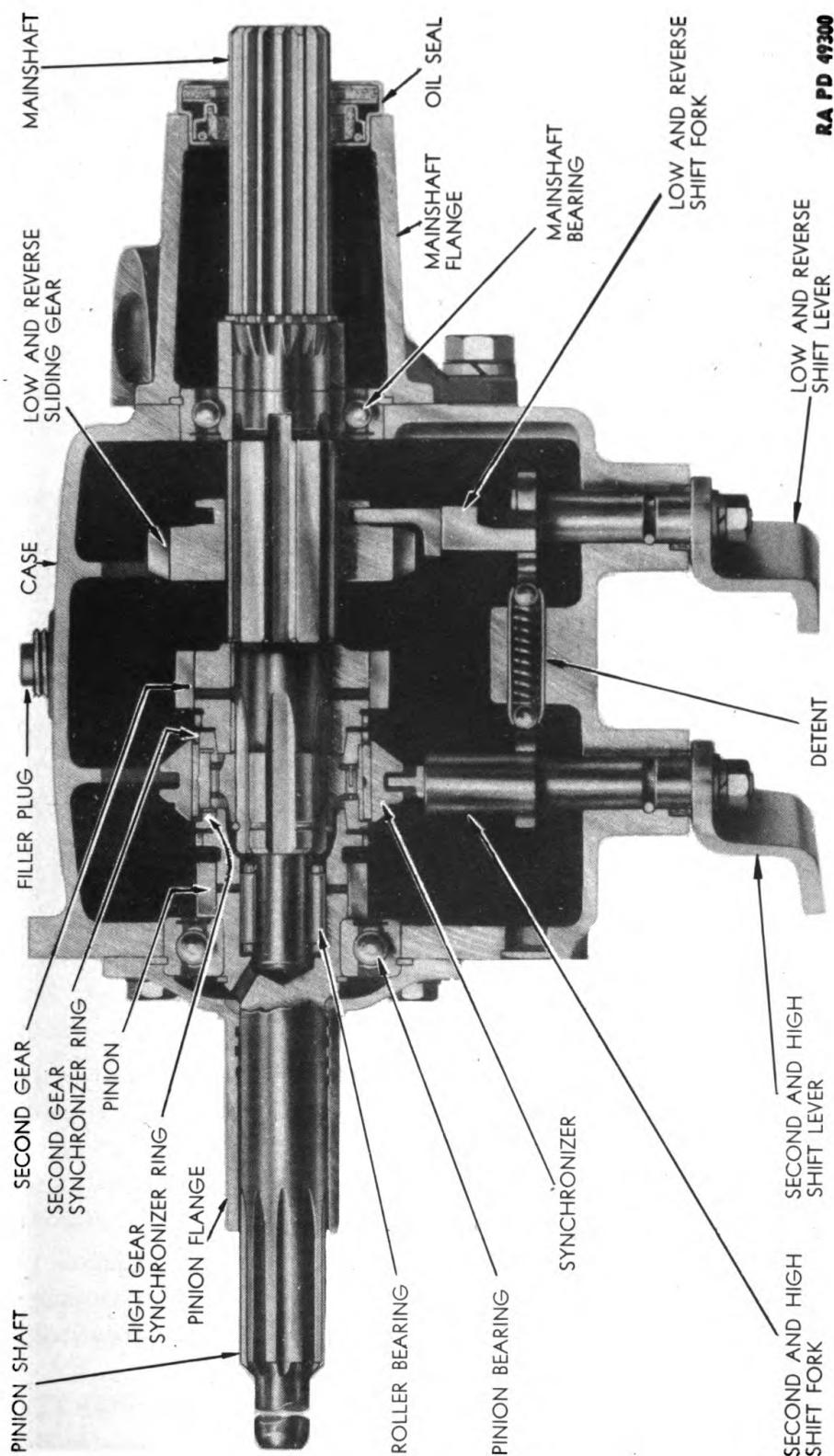


Figure 72—Transmission—Top Cross Section

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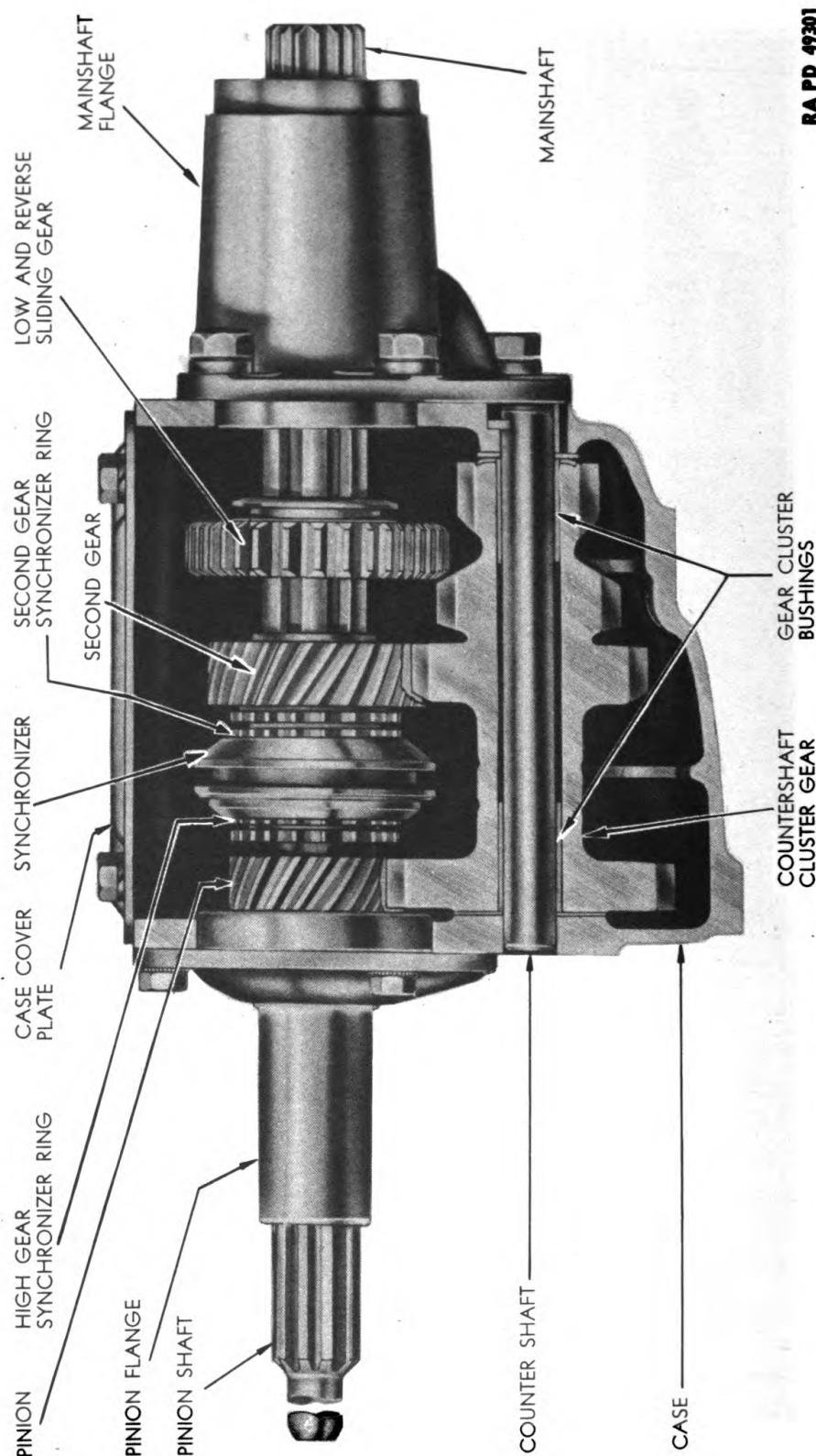


Figure 73—Transmission—Side Cut Away

TRANSMISSION

c. The splined forward end of the mainshaft is connected to the propeller shaft through a ground and splined sleeve or slip joint and yoke which is free to move ahead or rearward as required due to the movement of the cushion mounted engine. The outer ground surface of the sleeve bears against a spring loaded leather seal to prevent the escape of oil at the forward end of the transmission case.

86. LUBRICATION.

a. The transmission should be checked and lubricant added or replaced in exact accordance with the specifications set forth in section V. The drain and filler plugs are located on the left side of the transmission. Use a $\frac{1}{16}$ -inch open-end wrench to remove the filler plug or drain plug. The plugs are accessible by reaching between the assistant driver's seat and the hull, on the left side.

87. CONTROL LINKAGE ADJUSTMENT.

a. The transmission remote control shift lever is connected to the 2 transmission control levers on the right side of the transmission by rods supported on a bracket within the propeller shaft cover (fig. 21). To adjust the length of the rods, proceed as follows:

(1) Place the remote control shift lever in neutral and remove the cotter pins and clevis pins (pliers) connecting the rear ends of the 2 shift rods to the transmission control levers.

(2) With the shift rods disconnected, grasp the transmission control levers and move them to their neutral position. This can be determined by feeling the resistance of the detent plunger on the center notch of the transmission internal shift forks. The detent plunger will be in engagement with the center notch when, with the front axle shift lever in neutral, the propeller shaft can be turned by hand without disengaging the clutch.

(3) Loosen the clevis lock nuts ($\frac{9}{16}$ -in. open-end wrench) and turn each clevis clockwise to shorten the effective length of rods or counter-clockwise to lengthen the rods. The clevis pins must just enter the clevis eyes and the holes in the transmission control levers with a minimum of lost motion.

(4) Install the clevis pins, using new cotter pins, and tighten the clevis lock nuts securely. Check the adjustment by shifting into the different gear positions and oil the linkage points.

88. GEARSHIFT RODS AND LEVERS.

a. The shift rods and transmission control levers should operate easily and without excessive shifting effort from the driver. Periodic lubrication at the clevis on each end of the rods will assure free movement at these

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points. Exercise care to avoid straining the rods by bending or jamming from storing equipment over or between the rods.

b. Equipment.

HANDLE, ratchet

SOCKET, $\frac{7}{16}$ -in.

PLIERS

WRENCH, open-end, $\frac{7}{16}$ -in.

c. Removal.

(1) Remove the top and seats as directed in paragraph 55 a (1) and (2).

(2) Remove the 4 cap screws ($\frac{7}{16}$ -in. open-end wrench) with flat washers and lock washers and remove the propeller shaft cover. Disconnect the 2 remote control shift rods at both ends by removing the 4 cotter pins and clevis pins (pliers).

(3) Remove the bolt and nut ($\frac{7}{16}$ -in. socket, ratchet handle, and $\frac{7}{16}$ -in. open-end wrench) and the double U-clamp which positions the shift rods and through which the rods slide. Work the shift rods out from under the propeller shaft and out of the hull.

d. Installation. Tools as listed in subparagraph b above.

(1) Reverse the removal procedure when installing the shift rods.

(2) Adjust the control linkage as directed in paragraph 87.

89. TRANSMISSION.

a. Equipment.

BOLT, eye, engine lifting,

HOIST

HKM-J53

PLIERS

CHAIN, lifting

SCREWDRIVER

EXTENSION, socket

SOCKET, $\frac{9}{16}$ -in.

HANDLE, ratchet

WRENCH, box, $\frac{5}{8}$ -in.

b. Removal. To remove the transmission assembly, proceed as follows:

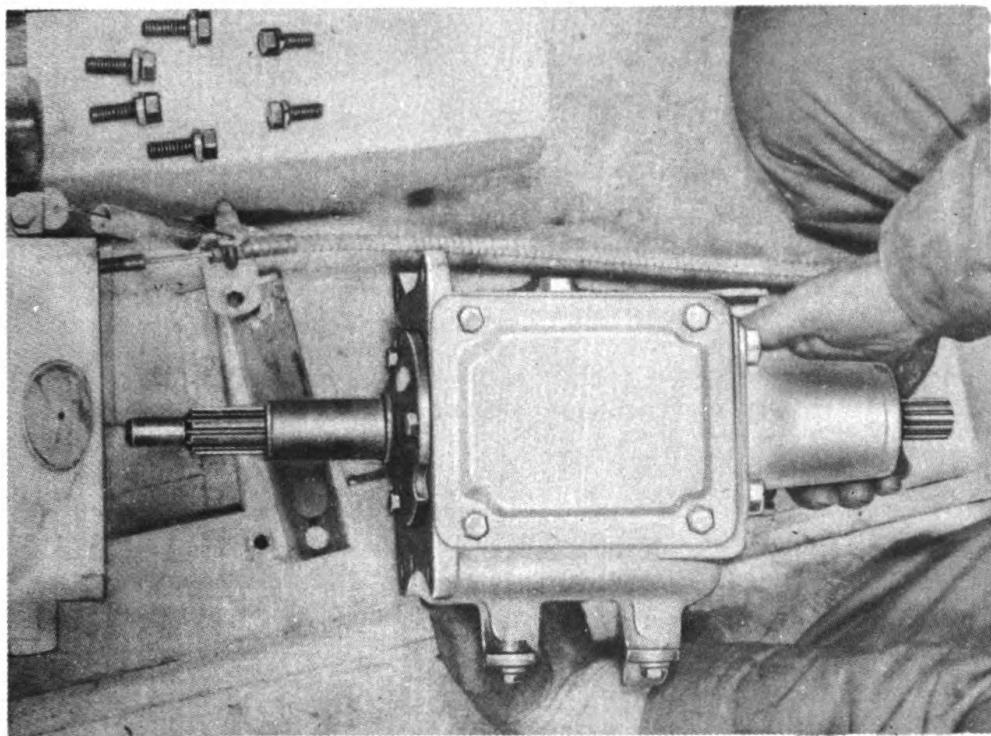
(1) Remove the propeller shaft and universal joints assembly by following the procedure given in paragraph 55 (3). Remove the 2 transmission support cushion to frame screws ($\frac{9}{16}$ -in. socket extension, and ratchet handle).

(2) Disconnect the remote control shift rods at the transmission control levers by removing the 2 cotter pins and clevis pins (pliers).

(3) Remove the engine front compartment lid hand wheels and raise the lid to its fully opened position, remove the engine front compartment screen as directed (par. 55 (4)), and install lifting eye HKM-J53 after draining the engine cooling system and removing cylinder head screw No. 6 (refer to the cylinder head tightening chart) (fig. 33).

(4) Attach a lifting chain to the eye and raise the hoist to support the weight of the front end of the engine.

TRANSMISSION



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Figure 74—Transmission Removal

(5) Remove the 4 cap screws ($\frac{5}{8}$ -in. box wrench) which secure the transmission to the clutch housing. While supporting the transmission assembly with the hands, move straight forward until the rear end of the transmission pinion has cleared the clutch housing. Lift the transmission out of the cockpit (fig. 74).

c. Installation. Tools as listed in subparagraph a above.

When installing the transmission, be sure it is lubricated adequately and that the gears shift satisfactorily. Before placing it in position, coat the clutch pilot (transmission pinion) bushing with GREASE, general purpose. Except for the above precautions, the removal procedure should be reversed when installing the transmission assembly. **CAUTION:** While the transmission is out of the vehicle, be careful not to drop anything in the forward bore of the clutch housing. Also, do not depress the clutch pedal because the clutch driven member will drop to the lower rim of the flywheel, making it impossible to install the transmission without realining the clutch driven member.

Section XVIII

PROPELLER SHAFT AND UNIVERSAL JOINTS

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Universal joints	92

90. DESCRIPTION.

a. The propeller shaft transmits the power developed by the engine from the transmission to the axle unit located in the front end of the hull. The shaft is fitted with universal joints at each end to permit smooth flow of power to the vehicle treads even though the engine operates in a lower plane than the axle unit (fig. 75). The propeller shaft is protected throughout its entire length by a sheet steel cover secured to brackets mounted on the floor of the hull.

b. Because of the flexible type engine mountings used, some movement of the engine occurs while it is in operation. The universal joints act both to fully compensate for the angle of the drive and for the side sway movement of the engine. Endwise movement of the engine on its cushions is provided for by the use of a splined slip joint at the rear of the shaft where it joins the transmission main shaft.

91. PROPELLER SHAFT.

a. **Lubrication.** The propeller shaft is of the hollow steel-tube type with welded universal joint yokes at each end. The shaft requires no lubrication.

b. **Equipment.**

HANDLE, ratchet	WRENCH, box, $\frac{1}{2}$ -in.
PLIERS	WRENCH, box, $\frac{5}{8}$ -in.
SOCKET, $\frac{7}{16}$ -in.	WRENCH, open-end, $\frac{1}{2}$ -in.

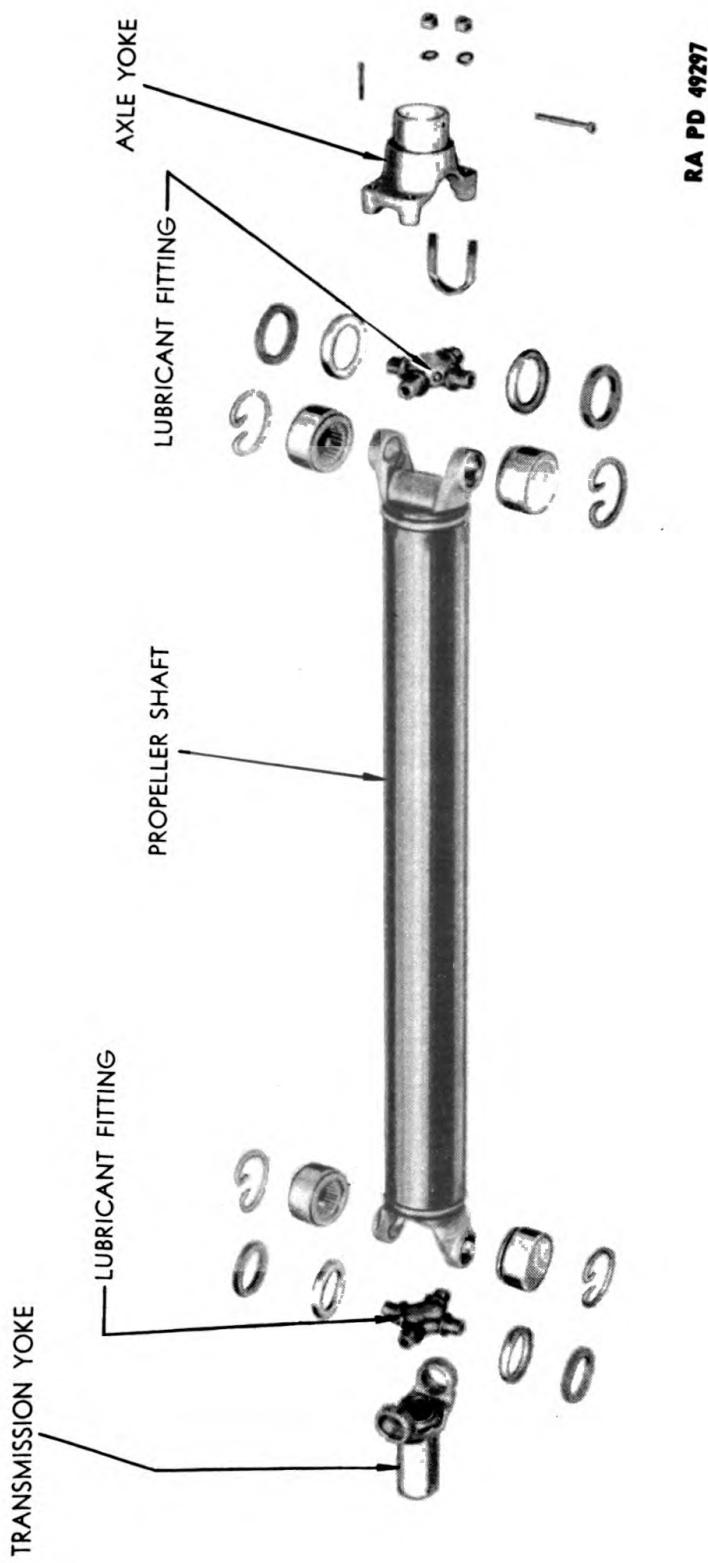
c. **Removal.**

(1) Remove the vehicle top, the driver's and assistant driver's seats, and the propeller shaft cover as outlined in paragraph 55 (1), (2) and (3).

(2) Remove the four U-bolt nuts ($\frac{1}{2}$ -in. box wrench) holding the front joint U-bolts to the axle unit driving flange and remove the U-bolts.

(3) Hold the 2 bearings released by removal of the U-bolts to prevent their falling off the cross and tap the shaft assembly rearward to free the held bearings from the retaining lugs of the axle unit driving flange.

PROPELLER SHAFT AND UNIVERSAL JOINTS



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Figure 75—Propeller Shaft and Universal Joint Parts

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(4) Lift the front end of the propeller shaft and pull forward to disengage the rear slip joint from the transmission main shaft splines.

(5) Lift the propeller shaft assembly out of the cockpit.

NOTE: If it is desired to replace the propeller shaft only, follow the procedure given (par. 92 e) in connection with removal and installation of universal joints.

d. Installation.

Tools as listed in subparagraph b above.

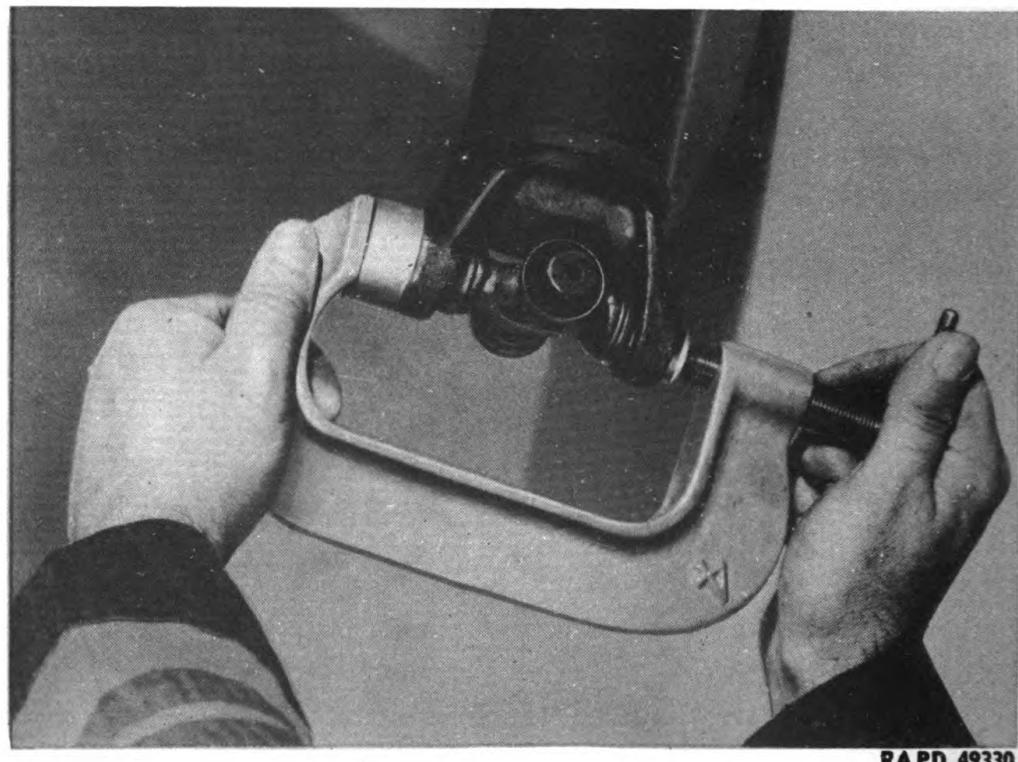
CLAMP, universal joint, HKM-J881A

Reverse the removal procedure to install the propeller shaft; however, be very careful to see that the free bearings of the front joint are fully seated between the lugs of the axle unit driving flange. To aid in this seating operation use clamp HKM-J881A.

92. UNIVERSAL JOINTS.

a. The 2 universal joints are of the needle-bearing type, completely sealed and positively locked in place.

b. Lubrication. Use a small, hand-operated, pressure gun, and grease the front and rear joint crosses as directed in section V. Lubricate sparingly the joint bearings at the lubricant fitting in each cross.



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**Figure 76—Removing Universal Joint Bearings,
Using Clamp HKM-J881A**

PROPELLER SHAFT AND UNIVERSAL JOINTS

c. Removal. When it becomes necessary to disassemble the joints for replacement of any of the component parts, proceed as follows:

CLAMP, universal joint, HKM-J881A **PLIERS**

- (1) Remove propeller shaft as outlined in paragraph 91 c.
- (2) With the shaft and joints assembly out of the vehicle, remove the free bearing assemblies.
 - (3) Place the shaft on a bench and grasp the loops of the lock rings (pliers); then compress and lift the lock rings out of the yoke eyes.
 - (4) Using clamp HKM-J881A, press one of the bearings inward toward the center of the yoke until it has cleared the yoke eye. When the one bearing has been pressed inward the opposite bearing will have been pressed outward and away from the cross into the adapter on the base of the clamp (fig. 76).
 - (5) The 2 bearings may be taken off the cross and out of the yoke.
 - (6) Proceed with the disassembly of the rear joint, first removing the bearings that are locked in the shaft yoke eyes and then the bearings that are locked in the slip joint yoke eyes. Follow exactly the same procedure as in the removal of the front cross.
 - (7) Wash all parts thoroughly in SOLVENT, dry-cleaning, and pry the oil seal retainers and oil seals off the 8 cross journals.

d. Installation.

Tools as listed in subparagraph c above.

HAMMER PUNCH, brass

- (1) Use a small amount of grease in each bearing cup to hold and locate the bearing needles and load each bearing cup with 12 needles. Install new retainers and cork oil seals on each journal of the cross. One of the bearing cups may be used over the end of the cross together with a vise to press the retainer and seals into position on the cross shoulders.
- (2) The crosses can be installed in the yokes by reversing the disassembly procedure. However, the lock rings should be examined carefully and any weak or badly distorted rings should be replaced.
- (3) After the reassembly is completed, use a brass punch and hammer to strike the cross toward each of the 2 bearings at the front and toward each of the 4 bearings at the rear in order to free the crosses at the seals.
- (4) Install propeller shaft as outlined in paragraph 91 c.

Section XIX

AXLE UNIT

	Paragraph
Description	93
Differential	94
Steering brake band adjustment	95
Axle speed control	96
Axle unit removal	97
Axle unit installation	98
Lubrication of axle unit	99
Axle drive wheels and shafts removal	100
Axle drive wheels and shafts installation	101

93. DESCRIPTION.

a. The axle unit is located in the extreme front of the hull and it functions to transmit power from the engine to the drive wheels and tracks. Actually, the unit is comprised of a two-speed transmission with integral differential and planetary gearing, 2 brake drums with hand levers for power steering as well as for braking, 2 wheel carrier housings, and 2 axle shafts to which the track drive wheels are secured. The vehicle speedometer drive is on the rear of the unit below the mainshaft flange (fig. 77).

94. DIFFERENTIAL.

a. The engine power carried forward by the propeller shaft from the transmission is delivered at the rear end of the axle unit transmission mainshaft. Splined to the mainshaft are 2 helical cut gears of different size; the larger one at the rear is the high speed gear, the smaller one at the front is the low speed gear. The mainshaft is carried on opposed tapered roller bearings.

b. Constantly in mesh with the mainshaft gears are the axle drive pinion gears carried on roller bearings. Whenever the transmission is in gear and the clutch is engaged, all 4 of these gears (2 mainshaft gears and 2 pinion shaft gears) are turning.

c. The 2 pinion shaft gears have internal teeth. Between them and splined to the pinion shaft is a sliding gear used to connect the pinion shaft with the power at the will of the driver.

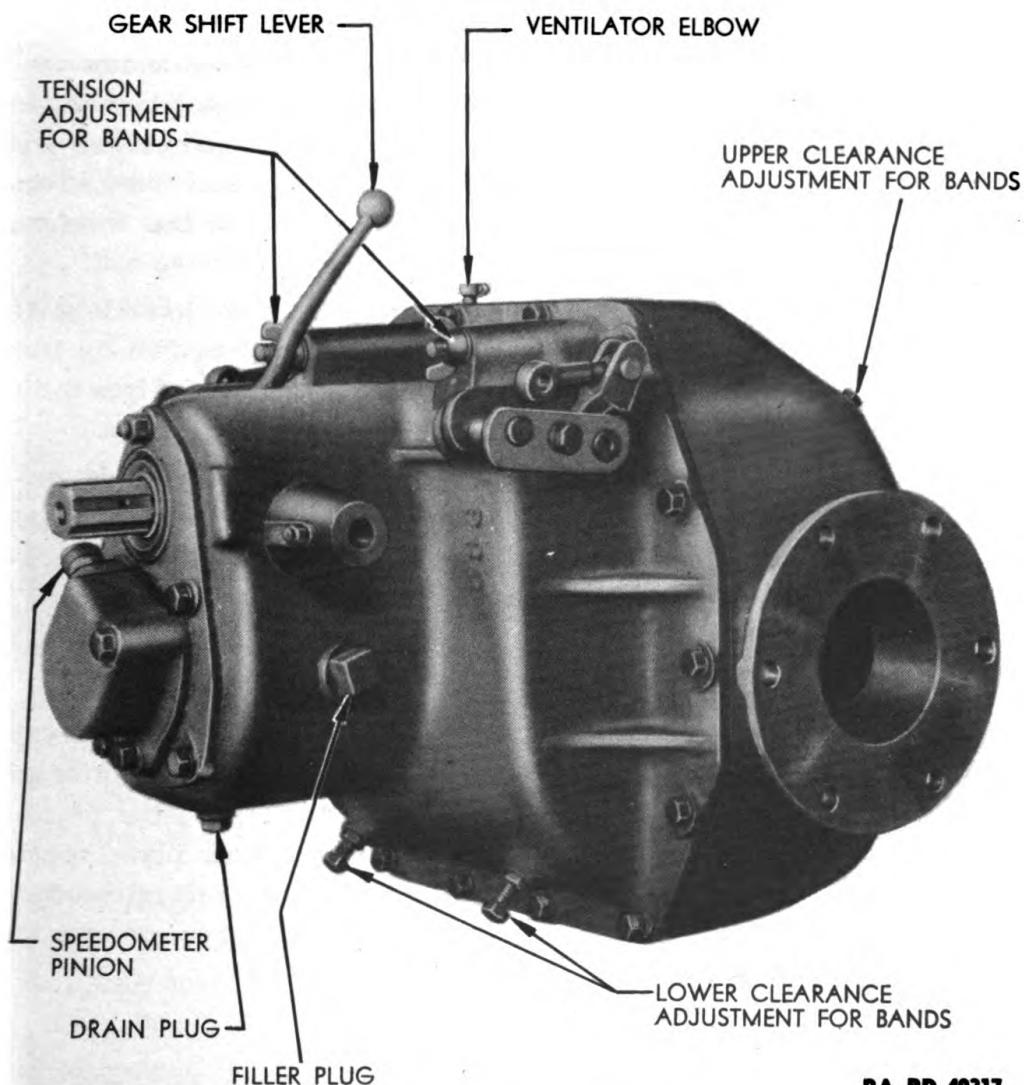
d. After being energized by one of the mainshaft gears, the pinion engaged with its ring gear rotates the drive wheels and vehicle tracks through a system of planetary differential gears.

AXLE UNIT

e. At each side of the differential the two planetary driving elements terminate within a brake drum which is connected by means of its geared flange to planetary gears. These gears in turn are keyed to the planetary pinions which drive the differential side gears carried in a forged spider housing mounted on the left of the ring gear. The side gears are splined to drive the axle shafts which are connected by means of flanges to the track drive wheels.

95. STEERING BRAKE BAND ADJUSTMENT.

a. Occasionally it will be necessary to readjust the brake bands as the lining and linkages wear. There are four adjustment points on each band —two adjustments are provided for limiting clearance, one for adjusting band tension, and another for shortening the travel of the steering levers.



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Figure 77—Axe Unit

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b. Equipment.

PLIERS

WRENCH, open-end, $\frac{9}{16}$ -in.

WRENCH, box, $\frac{9}{16}$ -in.

c. Adjustment.

(1) Turn clockwise the large wing nut used to set the tension of the band until the band can be felt to contact the drum. Then loosen the lock nuts on the band to drum clearance link screws ($\frac{9}{16}$ -in. open-end wrench). For each band 1 lock nut is located in the front wall of the cover and the other at the bottom of the axle carrier housing (fig. 77).

(2) Turn the adjusting screw ($\frac{9}{16}$ -in. box wrench) clockwise until the band contacts the drum. Then back off the screw (turning counter-clockwise) 2 flats ($\frac{1}{2}$ turn of the screw) to establish 0.020-inch to 0.025-inch clearance at these two points. While holding the head of the screw stationary with the $\frac{9}{16}$ -inch box wrench, tighten securely the lock nut ($\frac{9}{16}$ -in. open-end wrench).

(3) Returning to the large wing nut, turn the nut counterclockwise one or two notches. (The forward face of the wing nut is notched so that it can be turned only in $\frac{1}{2}$ -turn stages. By observation and feeling with the hands, the driver can tell when the notches are reached.) This adjustment should always be completed with the notches on the wing nut engaged with the stop ribs in the plate just ahead of the wing nut.

(4) Remove the cotter pin and the clevis pin (pliers) holding the brake band pull link to the steering lever. Shorten or lengthen by turning the free link as required to produce not more than 1 inch of free movement (at the top of the lever) before the effective stroke begins.

(5) Repeat the adjustment procedure on the other band and lever.

(6) When completing a general adjustment make sure that both levers have essentially the same braking effect and that the bands are not dragging on the drums with the levers released.

(7) Place a few drops of engine oil on the lever pivot pins and clevis pins.

(8) If for any reason it is necessary to remove the steering levers, proceed as follows: Remove the lever to operating rod clevis cotter pin and clevis pin (pliers). Remove the cap screw and lock washer ($\frac{9}{16}$ -in. open-end wrench) that secure the steering lever retainer plate, spacer, and spring to the axle unit. Move the lever toward the side of the cockpit and off the pivot pin. When installing the steering levers reverse this procedure.

96. AXLE SPEED CONTROL.

a. The axle shift lever is mounted just in front of the driver's seat on a cover at the left side of the axle unit housing. By moving the axle gear-

AXLE UNIT

shift lever rearward from neutral, the sliding gear moves forward to connect the engine power to the drive pinion through the mainshaft low speed gear. By moving the shift lever forward, the sliding gear is moved rearward to connect the mainshaft high speed gear with engine power. Thus, if the axle shift lever is in neutral, the propeller shaft can be turning but the vehicle will not move until the clutch is depressed and the axle shift lever is moved to either its high or low speed position. In general it is a good plan to leave the axle gearshift lever in the high speed position. When the terrain is such that the lower combination of driving speeds is desirable, the axle unit may be shifted to the lower range.

b. Each brake drum is encircled by a conventional brake band controlled by a steering lever. As one lever is pulled rearward, the band contacts the drum to retard or stop the corresponding axle shaft depending on the amount of rearward effort applied to the lever. At the same time, the speed of the opposite planetary element increases by virtue of the design of the gearing. Turning motion is time imparted to the vehicle when one track is slowed or stopped and the speed of the opposite track is automatically increased. If both levers are pulled rearward, the vehicle will come to a stop. In such a case the clutch must be disengaged or the engine will stall.

97. AXLE UNIT REMOVAL.**a. Equipment.**

BAR, drift	JACK, hydraulic (2)
BLOCK, wood	JACK, vehicle, SD903400
BRACKET, rear wheel tension spring release, SD902748	PAN, drain, shallow
CHAIN, lifting	PLIERS
EXTENSION, socket	SOCKET, $\frac{7}{16}$ -in.
HAMMER	SOCKET, $\frac{5}{8}$ -in.
HANDLE, jack, SD903401	SOCKET, $\frac{3}{4}$ -in.
HANDLE, ratchet	WRENCH, box, $\frac{1}{2}$ -in.
HOIST	WRENCH, box, $\frac{3}{4}$ -in.
JACK, floor	WRENCH, open-end, $\frac{7}{16}$ -in.
	WRENCH, open-end, $\frac{9}{16}$ -in.
	WRENCH, open-end, $1\frac{3}{16}$ -in.

b. Removal.

- (1) Remove the vehicle top, seats, and the propeller shaft as outlined in paragraph 55 b (1), (2) and (3).
- (2) Block up under the vehicle so that none of the vehicle's weight is supported on the tracks.
- (3) Using rear wheel tension spring release bracket SD902748, vehicle jack SD903400, and handle SD903401 pull the ends of the rear

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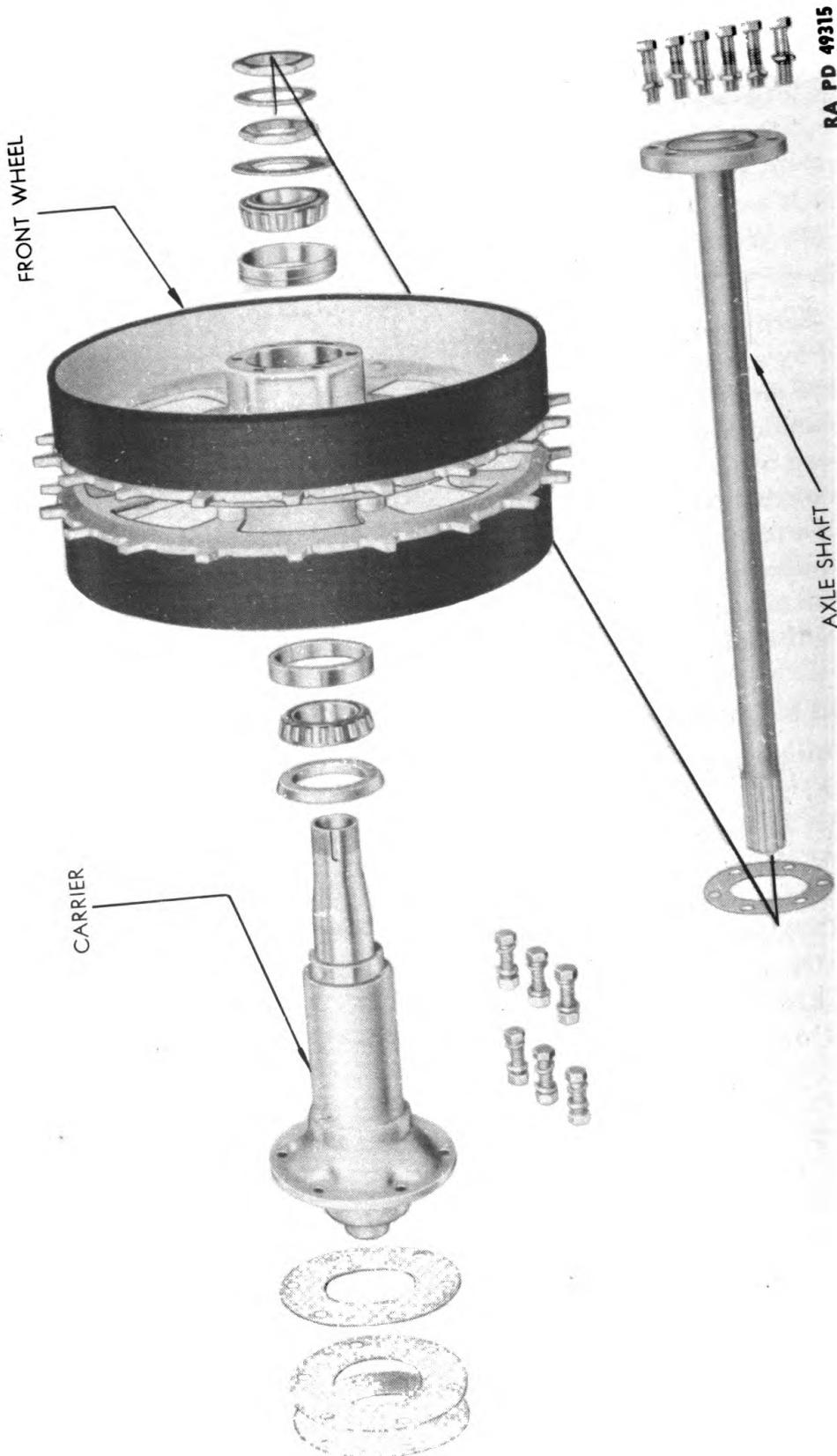
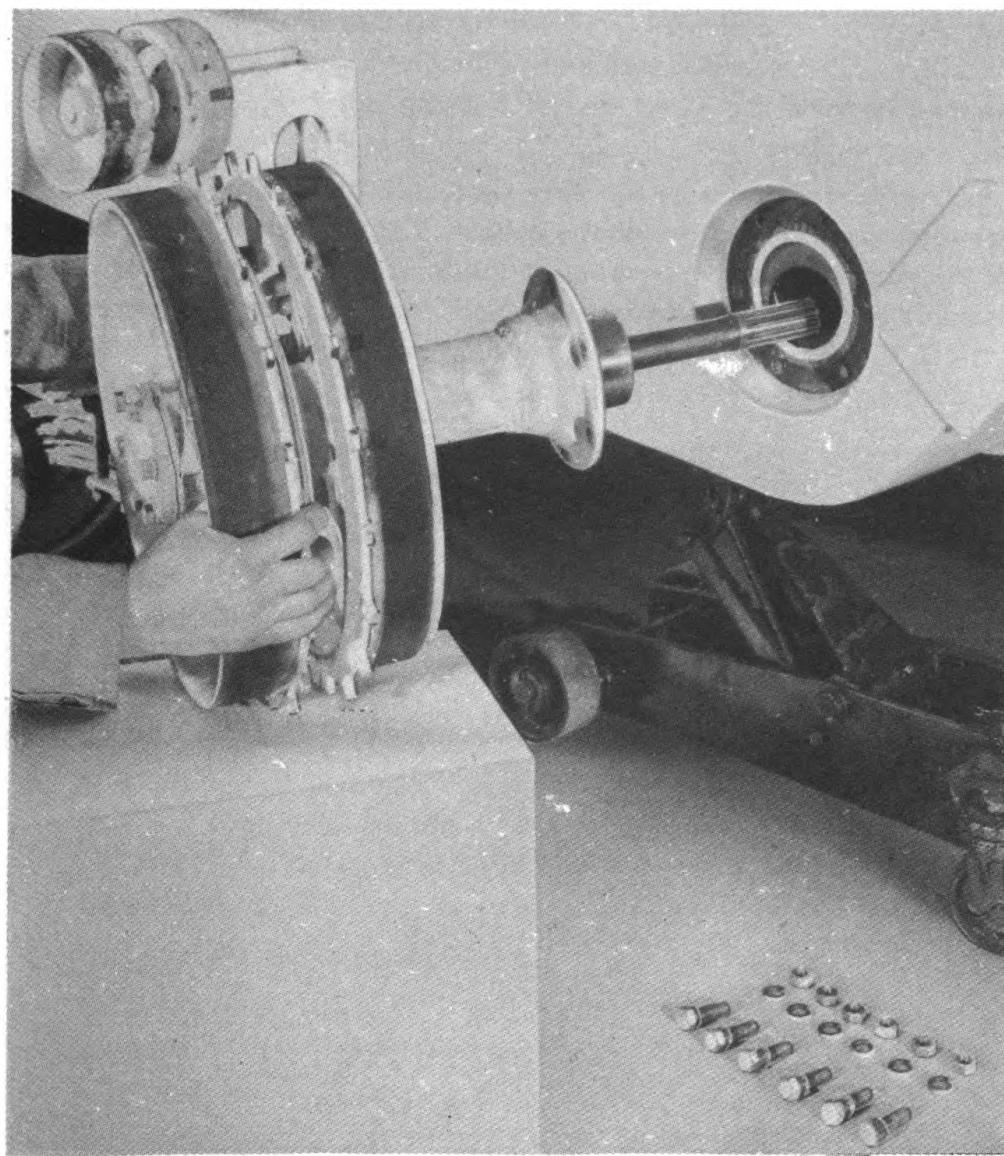


Figure 78—Drive Wheel, Shaft, and Carrier Parts

AXLE UNIT

wheel tension springs downward and remove the spring stop brackets to relieve the track tension on both sides. The operation as outlined in detail in paragraph 103 e, covers the track removal.

(4) It may be desirable to first remove both axle shafts after taking out the 6 shaft flange screws ($\frac{5}{8}$ -in. socket extension, and ratchet handle) at each drive wheel hub (fig. 78). Untie ropes and disconnect the holding clips ($\frac{1}{16}$ -in. socket extension, ratchet handle); then remove the protection pad over the top of the axle unit housing. Disconnect the axle unit ventilator pipe at the top of the unit ($\frac{7}{16}$ -in. open-end wrench) and carefully bend the pipe forward out of the way. Remove the bolt (screwdriver), lock, and nut ($\frac{1}{16}$ -in. open-end wrench) to free the clip



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Figure 79—Drive Wheel, Axle, and Carrier Removal

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on each bomb wiring tube and bend the tubes up to permit the axle unit to clear when raised. Disconnect the transmission remote control shift rods by removing the cotter and clevis pins (pliers). Loosen the speedometer cable adapter nut (pliers) and pull the cable out of the axle unit.

(5) Drain the lubricant out of the unit (shallow drain pan) by removing the drain plug ($\frac{1}{16}$ -in. open-end wrench) at the rear on the bottom of the unit. Pull the track forward and out of engagement with the drive wheel lugs. Using a $\frac{3}{4}$ -inch socket and ratchet handle while an assistant holds the bolt nuts ($\frac{3}{4}$ -in. box wrench) inside the cockpit, remove the wheel carrier housing to axle unit cover flange bolts, copper washers, and lock washers.

(6) Lift off the wheel carrier and drive wheel assemblies (fig. 79). If difficulty is experienced in removing the assemblies, use 2 hydraulic jacks blocked against the hull and drive wheel and a drift bar and heavy hammer to work the wheel carrier housing inner pilots out of the axle unit cover flanges.

(7) Attach a chain to the axle unit and, using a hoist, lift the unit rearward and upward out of the cockpit. While the unit is being lifted, the steering levers may be used to guide the unit and prevent any undesirable swinging action (fig. 80). Note that shims are used on each side between the hull and axle unit cover flanges. On assembly, the same number of shims must be installed at the side from which they were removed.



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Figure 80—Axe Unit Removal

AXLE UNIT

98. AXLE UNIT INSTALLATION.

a. **Equipment.** Tools as listed in paragraph 97 above.

b. **Procedure.** The installation of the axle unit requires no special instructions other than to reverse the removal procedure and fill with lubricant as directed in section V. Also, the track tension should be adjusted by following the procedure as outlined in paragraph 103 a.

99. LUBRICATION OF AXLE UNIT.

a. The axle parts, including the axle transmission differential, run in oil. The unit must be serviced as directed in section V. The lubricant filler plug is located on the right side of the unit cover and may be removed with a $1\frac{3}{16}$ -inch open-end wrench. The axle unit ventilator requires no servicing. The drain plug is located near the rear of the unit on the bottom and may be removed with a $\frac{9}{16}$ -inch open-end wrench.

100. AXLE DRIVE WHEELS AND SHAFTS REMOVAL.

a. **Equipment.**

Tools as listed in paragraph 103 a, below.

BLOCK, wood	SOCKET, $\frac{9}{16}$ -in.
CHISEL	SOCKET, $\frac{5}{8}$ -in.
HAMMER	WRENCH (2 $\frac{3}{8}$ -in.),
PUNCH, brass	SD903856
SCREW, cap, N.C., $\frac{3}{8}$ -in. (2)	

b. **Removal.**

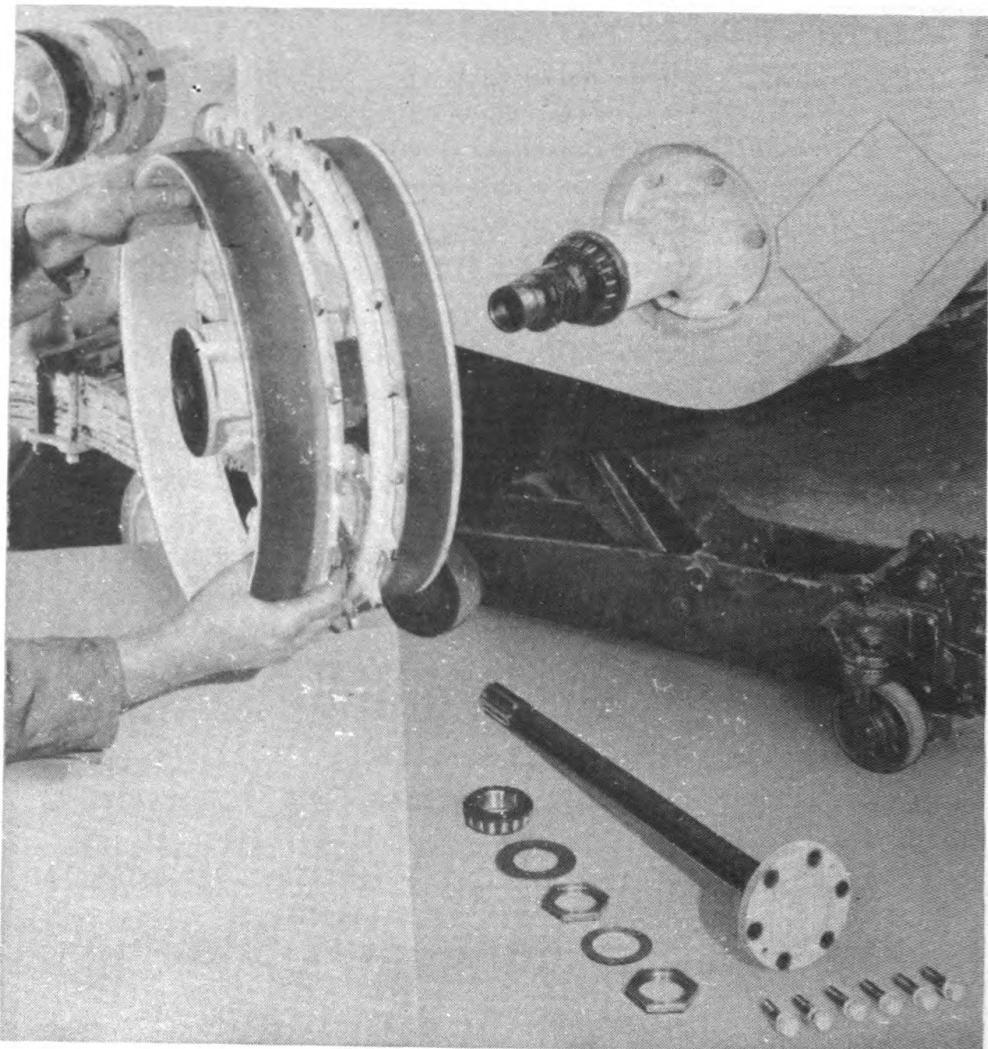
(1) Relieve the track tension on the side where the drive wheel is to be removed, following the procedure given in paragraph 103 b (5).

(2) Remove the axle shaft flange screws ($\frac{5}{8}$ -in. socket, and ratchet handle). If the axle shaft cannot be removed by hand, insert two $\frac{3}{8}$ -inch No. C cap screws in the threaded holes of the axle shaft flange and turn the screws clockwise ($\frac{5}{8}$ -in. open-end wrench) to push the flange away from the drive wheel hub. Remove the axle shaft and take out the pusher screws. Scrape off the flange gasket and on reassembly, apply a new gasket, using GREASE, general purpose, to hold the gasket in place.

(3) Unlock (chisel and hammer) and remove the drive wheel bearing lock nut, lock, and adjusting nut (2 $\frac{3}{8}$ -in. wrench SD903856).

(4) Remove the drive wheel with outer bearing and inner cup and remove the oil seal and outer bearing from the hub of the drive wheel (fig. 81). Drive out the bearing cups if the cones are to be replaced (brass punch and hammer). Slide the inner bearing cone off the carrier housing spindle. Clean thoroughly with SOLVENT, dry-cleaning, the inside of the drive wheel hub and the bearings.

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RA PD 49365

Figure 81—Drive Wheel Removal

101. AXLE DRIVE WHEELS AND SHAFTS INSTALLATION.

a. **Installation.** Tools as listed in paragraph 100 a above.

(1) Install the bearing cups by carefully driving them into place (wood block and hammer). Pack the inner bearing cone with **GREASE**, general purpose (seasonal grade), install the bearing, and install a new oil seal.

(2) Pack the outer bearing with GREASE, general purpose (seasonal grade), install the drive wheel, and adjust the bearings (wrench SD903856) until they are seated firmly and the wheel turns hard; then back off the adjusting nut $\frac{1}{8}$ turn. Install the lock and lock nut and set the lock (chisel and hammer).

(3) Install the axle shaft and tighten the flange screws ($\frac{5}{8}$ -in. socket, and ratchet handle) securely.

(4) Engage the track with the drive wheel and adjust the track tension as outlined in paragraph 103 b.

Section XX

TRACKS AND SUSPENSIONS

	Paragraph
General description	102
Tracks	103
Rear wheels	104
Bogie wheels	105
Guide wheels	106
Grouser plates	107

102. GENERAL DESCRIPTION (fig. 82).

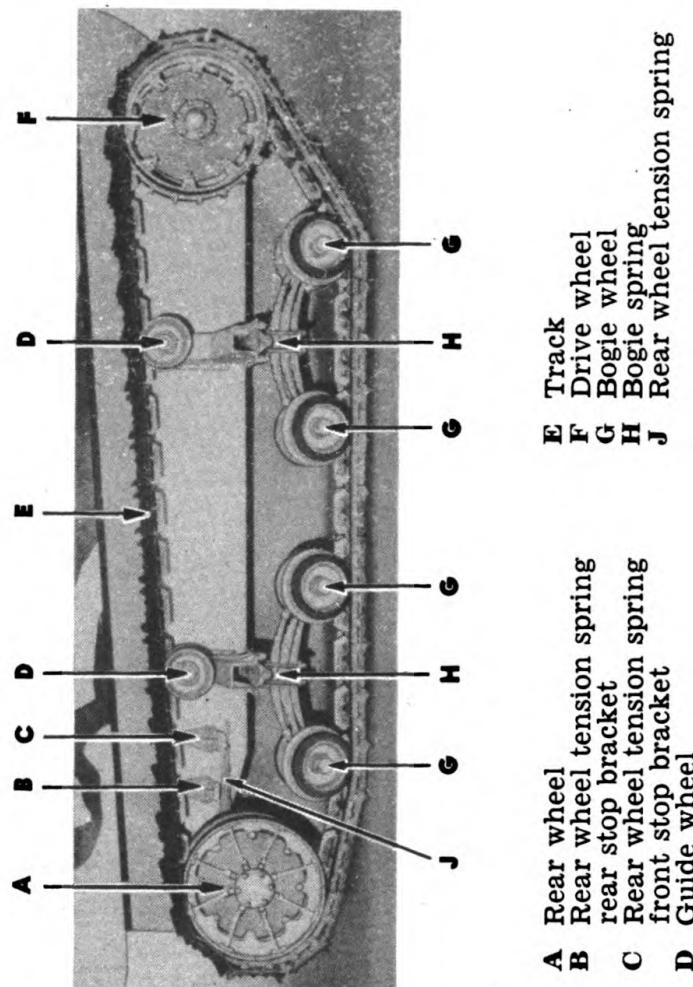
a. Two individually driven tracks propel the vehicle forward or backward. Each track is composed of 41 rubber covered track shoes called grouser plates; the plates are spaced $\frac{1}{4}$ inch apart and each plate accounts for 6 inches of the track length. The grouser plates are riveted individually to 2 fabric rubber bands which act as the backbone of the track.

b. At the front, on each side of the vehicle, is a drive wheel driven by the axle unit through an axle shaft. The shaft is splined on its inner end to engage the splines of the differential side drive gears and flanged at its outer end. The outer flange is held securely to the drive wheel by 6 cap screws based in the hub of the drive wheel. The drive wheel is supported by tapered roller bearings on the outer machined surface of the wheel carrier housing. The housing is, in turn, joined to the axle unit by close fitting machined pilots and secured by 6 bolts, copper washers, and nuts with locks. The bolts extend through the hull of the vehicle.

c. An individually sprung rear wheel is mounted on each side of the vehicle at the rear of each track to maintain the track spacing and to provide a means for adjusting and changing the track tension. A cantilever-type spring employing a segment of a semielliptic spring is used at each rear wheel. The butt (rear) end of the spring is secured to a crank arm pivoted on each side of the hull at the rear. The crank arm spring is stopped from moving upward at its front end by 2 stop brackets attached to the side of the hull. The front bracket limits the upward travel of the spring end and is always in contact with the spring. The rear bracket acts to augment the front bracket in cases of sharp and severe shocks to the track at the rear of the vehicle, such as when striking a perpendicular obstacle while backing. The rear wheel turns on opposed tapered roller bearings carried on a spindle at the end of the crank arm.

d. The vehicle rides the track on 4 bogie sets, 2 on each side. Each

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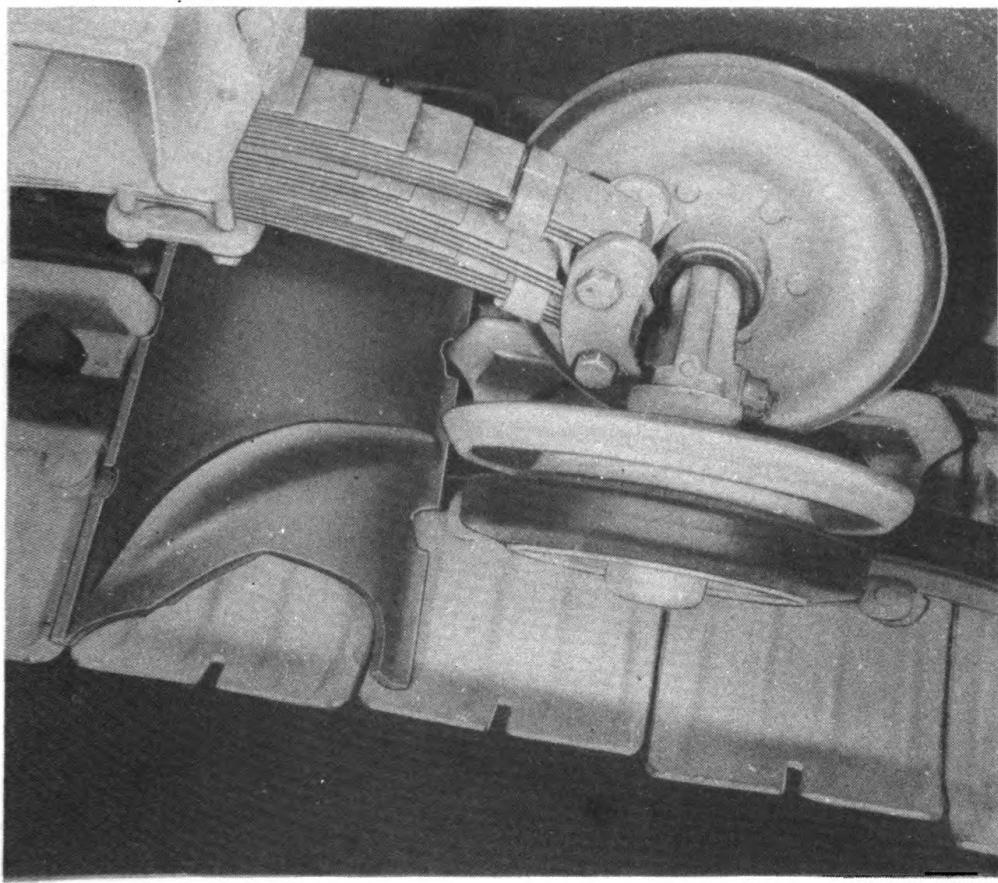
Figure 82—Track and Suspension Assembly

TRACKS AND SUSPENSIONS

bogie set employs a semielliptic, 3-section spring, the center of which is secured by U-bolts to a seat which is pivoted on a hull bracket. The bogie wheels at both ends of each spring are shackled to the spring eyes in pairs (one riding each belt band) through a yoke and double spindle bracket. The bogie wheels are free to move upward and downward within the limits of the spring flexing ability as fixed by stop bumpers and are permitted to move axially by the semiuniversal mounting of the spindle brackets to the spring yokes. Each bogie wheel is rubber tired with a band of solid rubber where it contacts the rubber belt of the track. The bogie wheels are supported individually on sealed, opposed tapered roller bearings carried on the spindle brackets.

e. Four track guide wheels (2 on each side) are used to support and guide the track. Each guide wheel is borne on 2 needle-type bearings.

f. In the event the bogie wheels at one end of the spring are forced off the track belts, the wheels can be easily directed back into the belts



RA PD 49396

**Figure 83—Rerailing Bogie Wheels onto Track Belt—
Rerailer SD903412**

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using track rerailer SD903412 (fig. 83). To function, the rerailer must be placed between the front and rear wheels of the bogie set involved. If the wheels are off toward the outer edge of the track, the notches in the rerailer must be so engaged with the track inner guide lugs that the wedge on the rerailer strikes the outer bogie wheel. If the wheels are off toward the inside of the track, the rerailer must be so positioned that the wedge contacts the inner bogie wheel. When the front wheels of a bogie set are off, drive the vehicle in reverse so the wheels will climb over the rerailer and spring into position on the track belts. If rear bogie wheels are involved, drive the vehicle forward.



RA PD 49370

Figure 84—Positioning Track Tension—Gage SD902836

TRACKS AND SUSPENSIONS

103. TRACKS.

a. Equipment.

BRACKET, rear wheel tension
spring release, SE902748

EXTENSION, socket

GAGE, track spring tension,
SD902836

HANDLE, jack, SD903401

HANDLE, ratchet

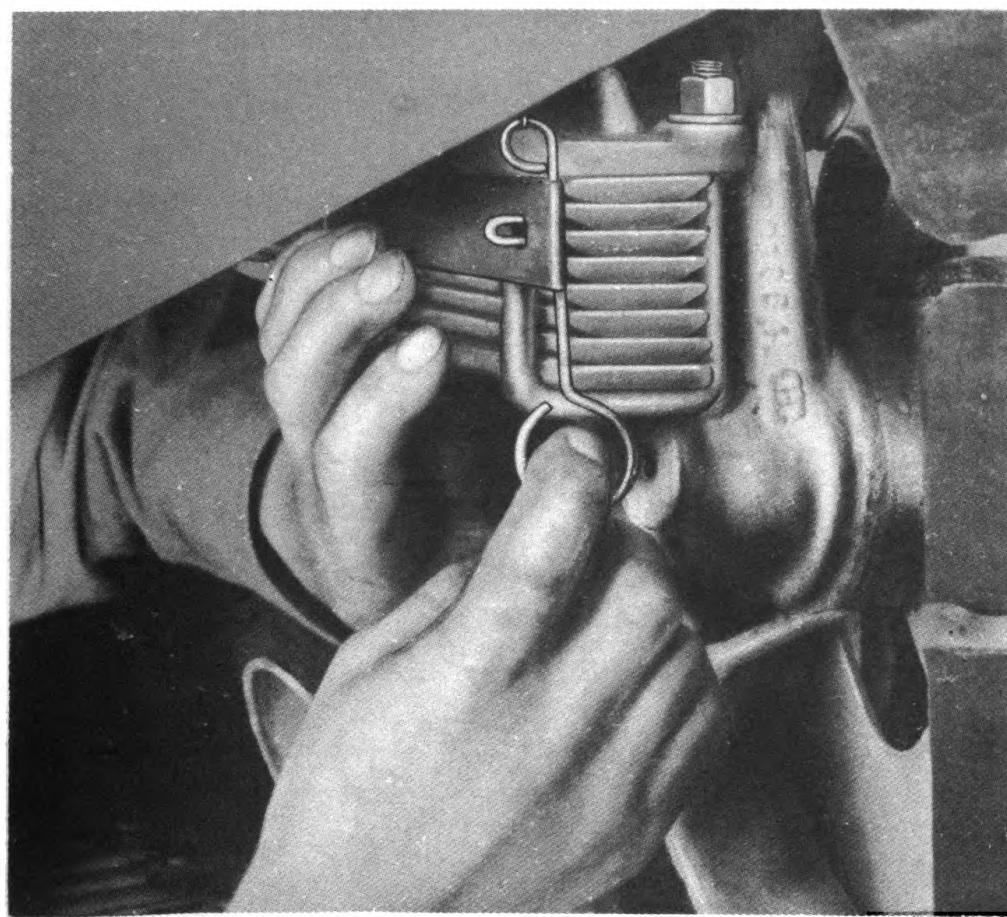
JACK, vehicle, SD903400

SOCKET, $\frac{1}{2}$ -in.

b. Adjustment.

(1) Wipe any mud or foreign matter off the narrow machined edge of the rear wheel spring seat which is exposed between the rear end of the rear wheel spring and the hull.

(2) With the pointer of track spring tension gage SD902836 toward the front, engage the locating ears at the rear of the gage between the spring U-bolts and flat against the machined surface of the spring seat (fig. 84). Draw the gage hook and spring up and around the crank arm and engage the hook in the hole near the rear of the gage (fig. 85).



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Figure 85—Hooking Track Tension Gage in Place

LIGHT CARGO CARRIER T-15

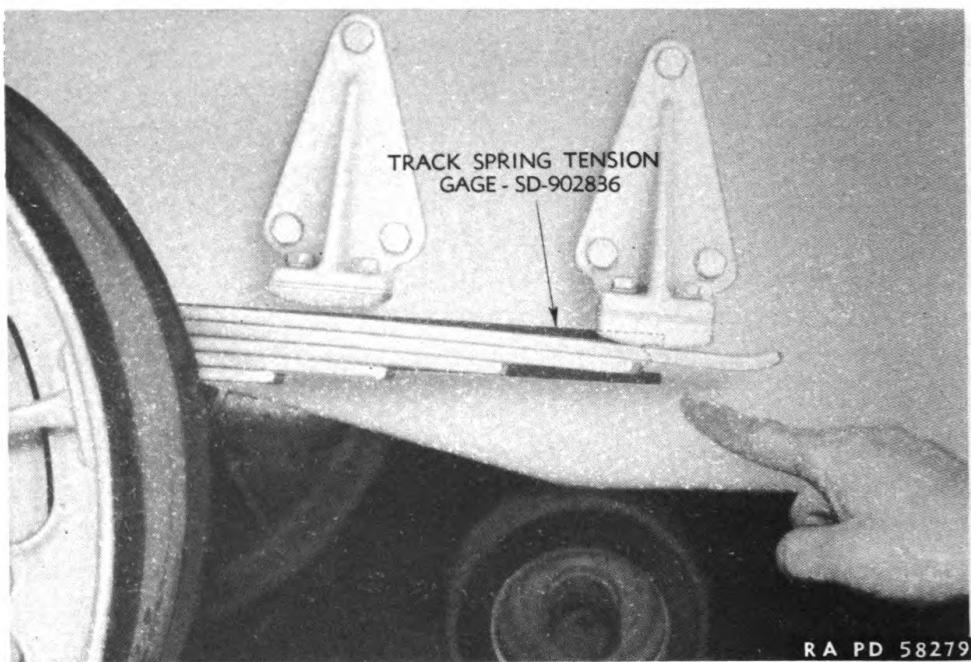


Figure 86—Checking Track Tension

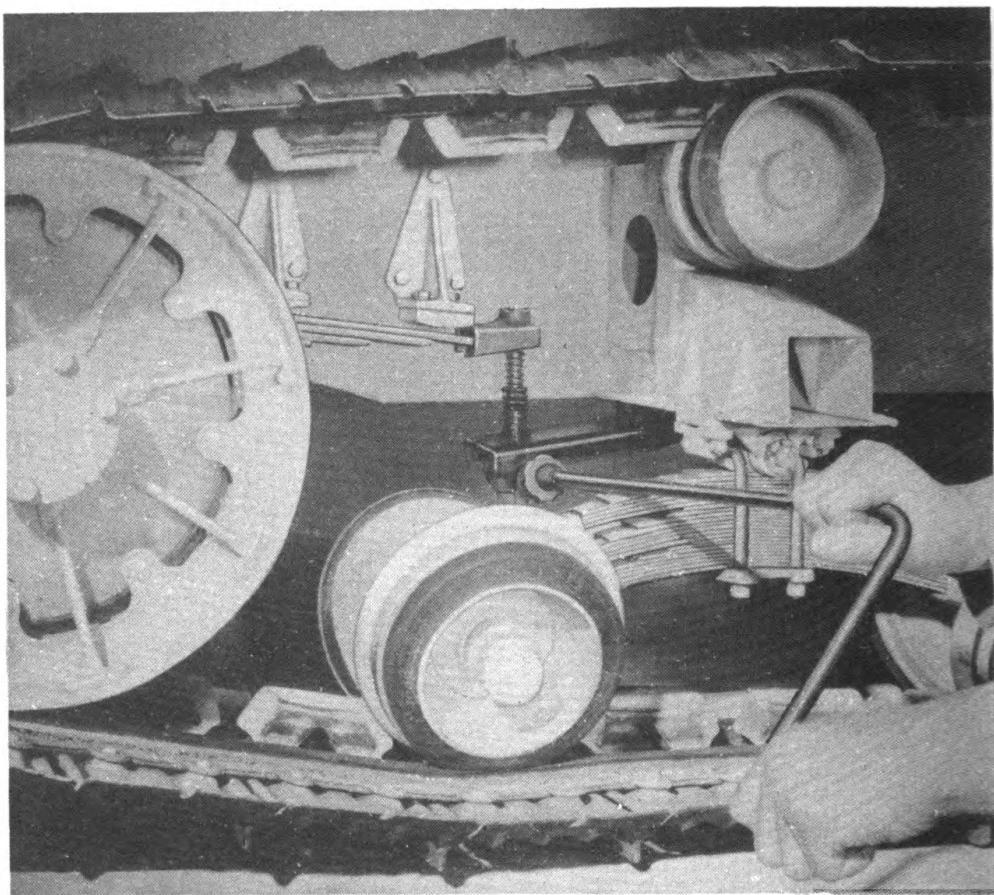
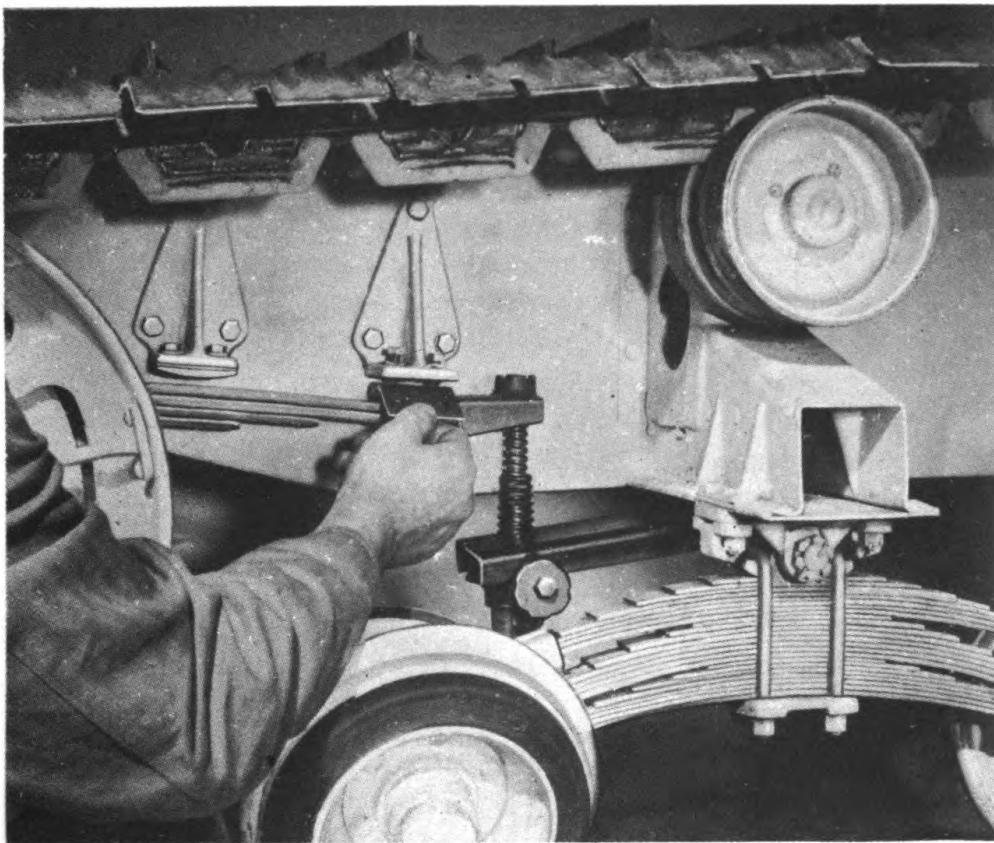


Figure 87—Relieving Track Tension

TRACKS AND SUSPENSIONS



RA PD 49373

Figure 88—Shimming Spring Stop Bracket to Adjust Track Tension

(3) Note the position of the tip of the pointer with relation to the top leaf of the spring. If the tip of the pointer is below the top leaf of the spring, the track is too loose. If the tip of the pointer is above the top leaf of the spring, the track is too tight and, in either case, the track must be adjusted.

(4) The track tension is reduced by removing shims between the convex wear pad at the tension spring front stop bracket and the lower face of the bracket. The track tension can be increased by installing shims at this point (fig. 86).

(5) If the track requires adjustment, pull the front end of the tension spring downward using rear wheel tension spring release bracket SD902748, which must be hooked under the bogie and idler wheel to hull bracket and around vehicle jack SD903400. The bracket on top of the jack screw is then hooked over the top leaf of the tension spring which projects beyond the front stop bracket. Operate the jack with handle SD903401 to move the spring end downward (fig. 87).

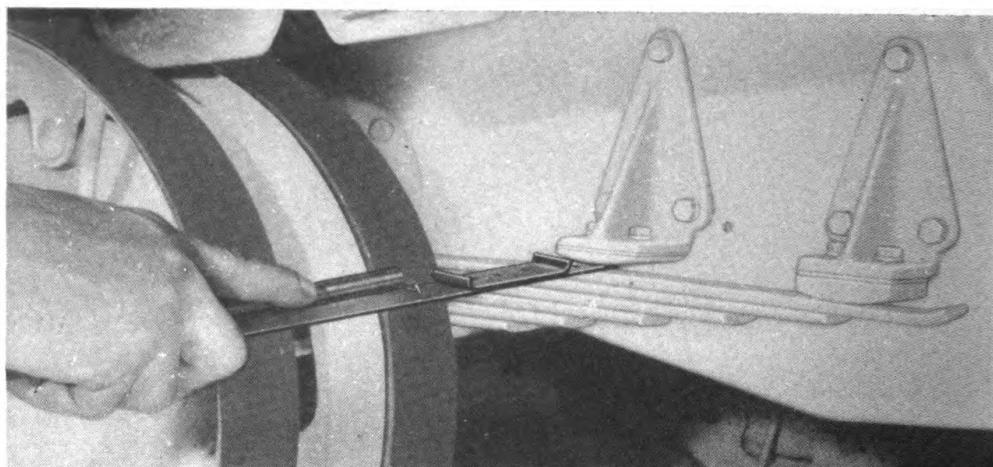
(6) After the top leaf of the spring has been pulled out of contact with the wear pad, remove the 2 cap screws (1/2-in. socket extension, and

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ratchet handle) to free the wear pad and add or remove shims, as required, to adjust the height of the spring to coincide with the tip of the gage pointers (fig. 88).

(7) After the adjustment has been completed, line up the shims and the wear pad, install and secure the cap screws.

(8) Using the $\frac{3}{16}$ -inch thickness gage (part of the track spring tension gage), check the clearance between the rear stop bracket and the top leaf of the spring (fig. 89). If more or less clearance than $\frac{3}{16}$ inch exists at this point, add or remove shims as in the case of the front stop bracket. Usually the rear stop bracket will require adjustment at the same time as the front bracket to maintain the $\frac{3}{16}$ -inch clearance. The rear wheel tension spring release bracket is not needed in adjusting at this point.



RA PD 49371

Figure 89—Checking Rear Spring Stop Bracket for Clearance—Gage SD902836

c. Removal.

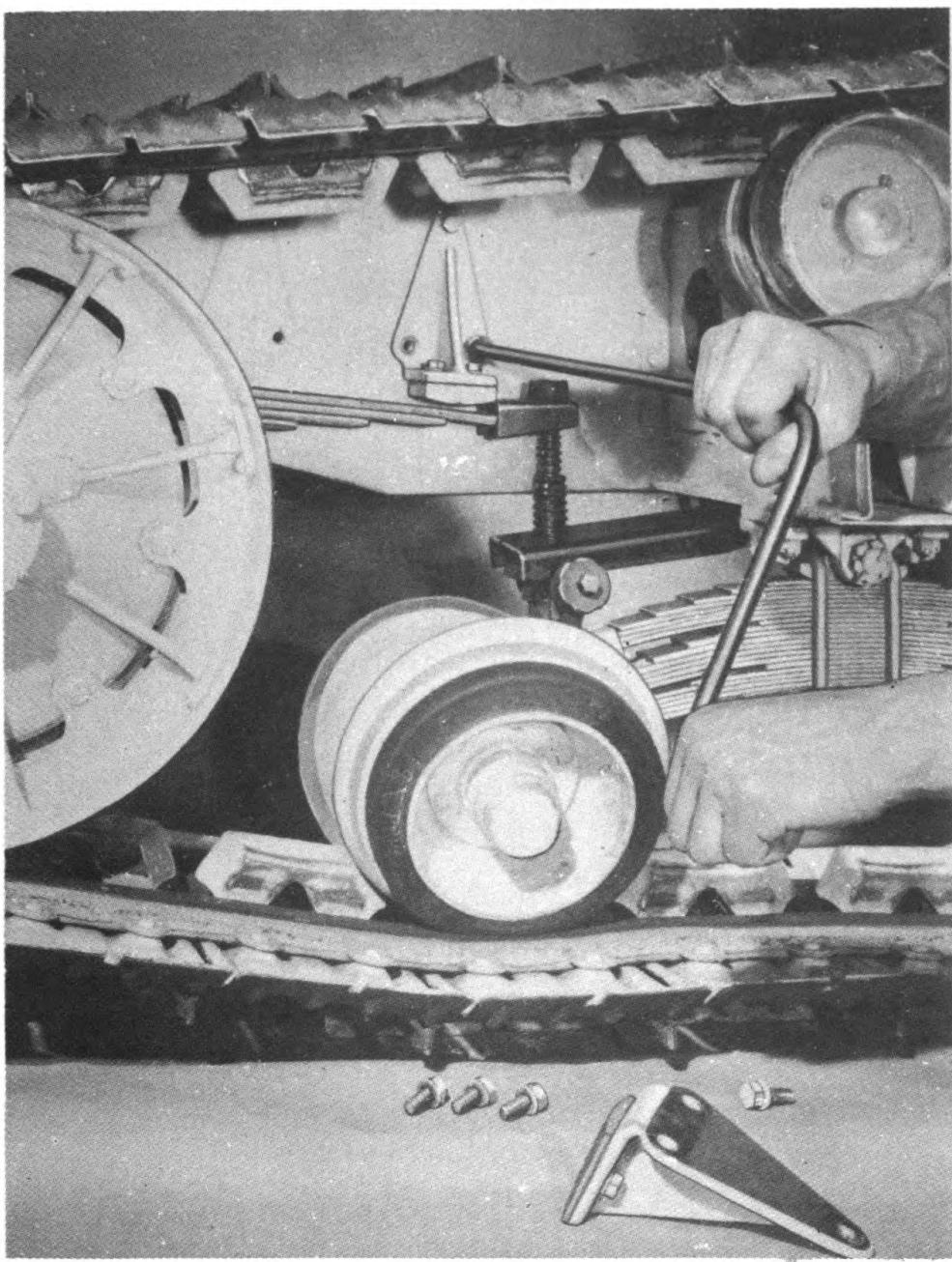
BLOCK, wood	HANDLE, jack, SD903401
BRACKET, rear wheel tension spring release, SD902748	HANDLE, ratchet
EXTENSION, socket	JACK, floor
	JACK, vehicle, SD903400
	SOCKET, $\frac{1}{16}$ -in.

(1) Block up the vehicle on the side where the track is to be removed in order to free the track of the vehicle's weight.

(2) Pull the front end of the rear wheel spring (rear wheel tension spring release bracket SD902748, vehicle jack SD903400, and handle SD903401) down out of contact with the spring front stop bracket.

(3) Take out the 3 cap screws ($\frac{1}{16}$ -in. socket extension, and ratchet handle) holding the rearward stop bracket to the hull and remove the bracket assembly.

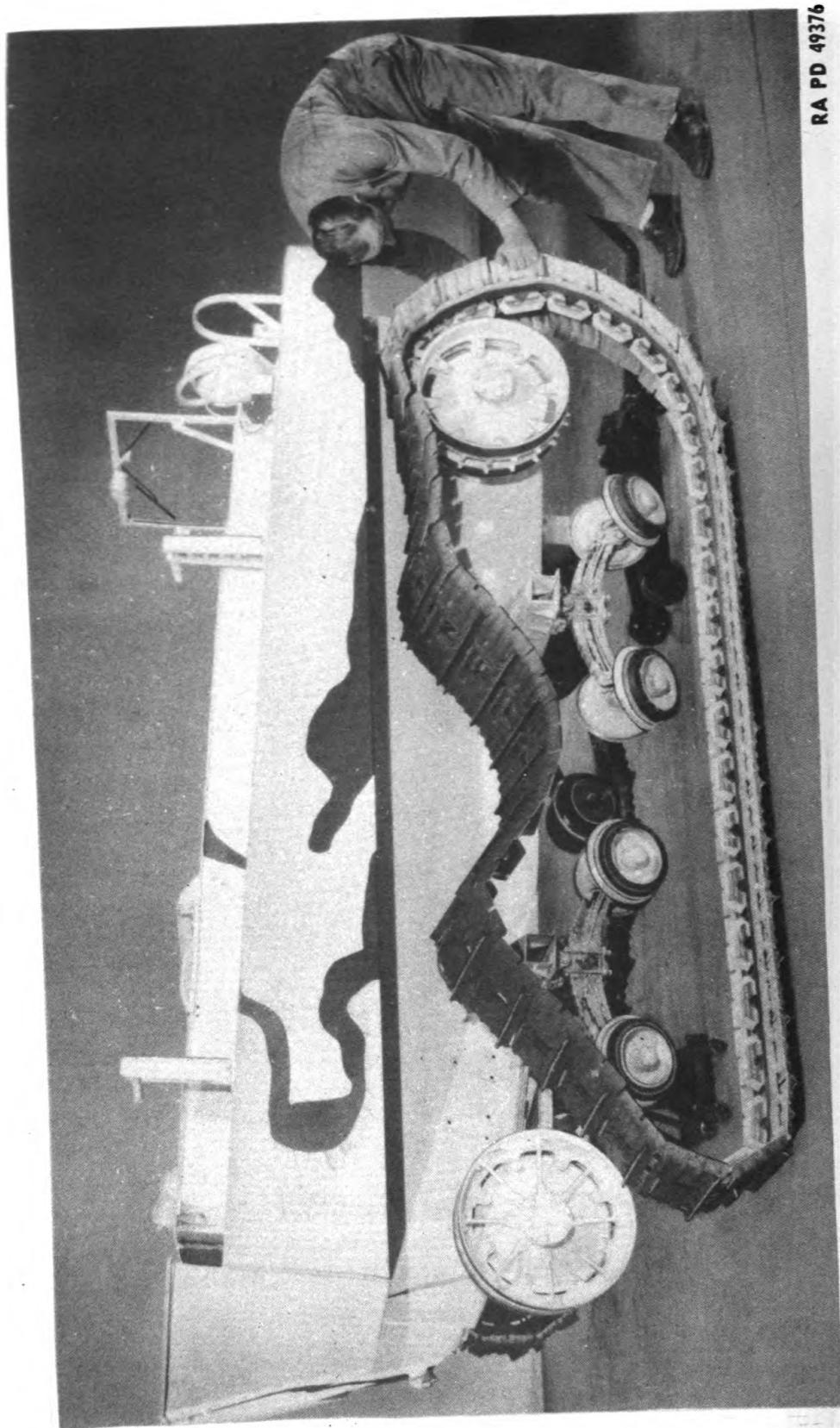
TRACKS AND SUSPENSIONS



RA PD 49374

Figure 90—Rear Wheel Spring Stop Brackets Removal

- (4) Remove the forward stop bracket in the same manner (fig. 90).
- (5) Release the spring until its front end arcs up under the hull. This will allow the crank arm holding the rear wheel to move forward and relieve the track tension.
- (6) Pull the track rearward out of engagement with the rear wheel and remove the track from the suspension system (fig. 91).



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Figure 91—Vehicle Track Removal

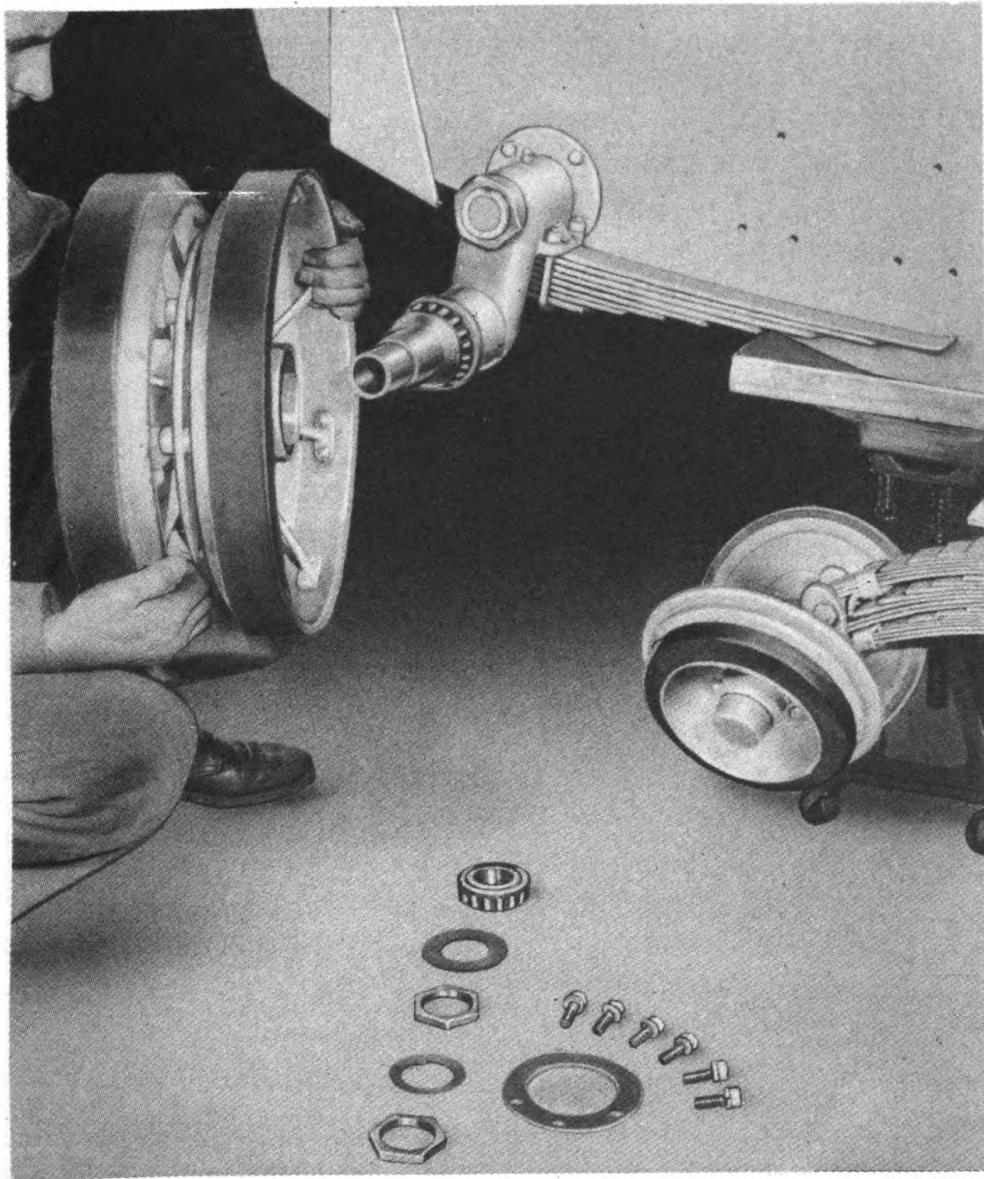
TRACKS AND SUSPENSIONS

d. Installation. Tools as listed in subparagraph a and c above.

NOTE: The tracks are designed for principal operation in one direction, with the short grouser leading. Do not reverse the tracks on the vehicle so that the long grousers on each plate will lead or pass the drive wheel before the short grouser on forward operation.

e. Reversal.

The track is installed by reversing the removal procedure. While rear wheel tension release spring bracket SD902748 and vehicle jack SD903400 are in place and after the stop brackets have been installed, the track tension must be adjusted as outlined in paragraph 103 b.



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104. REAR WHEELS.

a. Equipment.

BLOCK, wood

BRACKET, rear wheel tension spring release,
SD902748

CHISEL

HAMMER

HANDLE, jack, SD903401

HANDLE, ratchet

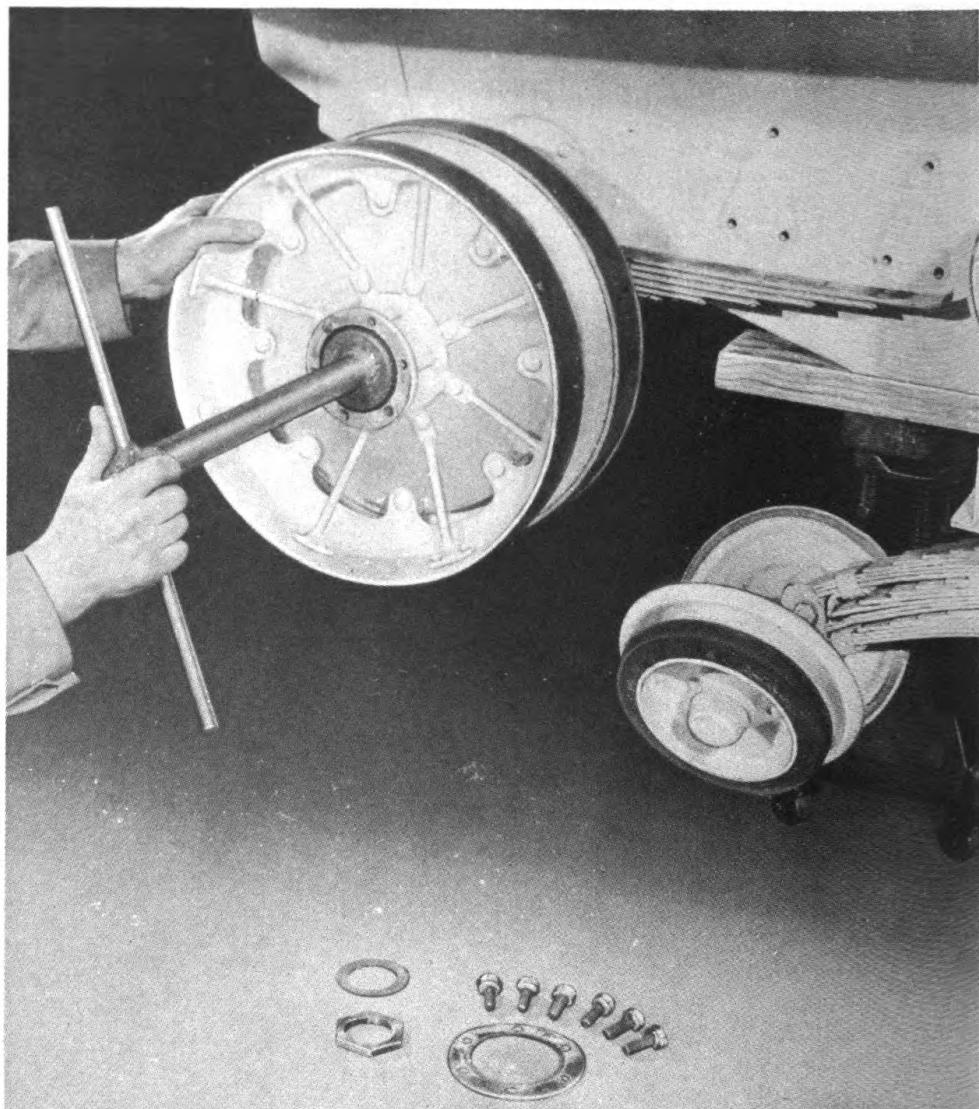
JACK, floor

JACK, vehicle, SD903400

SOCKET, $\frac{5}{8}$ -in.WRENCH, $2\frac{3}{8}$ -in., SD903856

b. Removal.

(1) Relieve the track tension as outlined in paragraph 103 b (5).



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Figure 93—Rear Wheel Bearing Adjustment Wrench SD903856

TRACKS AND SUSPENSIONS

(2) Remove the 6 screws (5/8-in. socket and ratchet handle) holding the hub cover to the rear wheel hub.

(3) Unlock (chisel and hammer) and remove the bearing lock nut, lock, and bearing adjusting nut (2 3/8-in. wrench SD903856); then lift off the wheel and bearings (fig. 92).

c. Installation. Tools as listed in subparagraph a above.

(1) Prior to installing the rear wheel, the bearings should be cleaned thoroughly in SOLVENT, dry-cleaning, and they should be hand packed with GREASE, general purpose, seasonal grade. Also, the oil seals should be replaced if inspection shows new seals are needed (fig. 94).

(2) Install the rear wheel on the crank arm and adjust the bearings with the adjusting nut (2 3/8-in. wrench SD903856) until it is hard to turn the wheel. Then the adjusting nut should be backed off 1/16 turn to give the proper final adjustment (fig. 93).

(3) Install the lock nut (2 3/8-in. wrench SD903856) and lock (chisel and hammer).

(4) Install the hub cover (5/8-in. socket, and ratchet handle) with new gasket.

(5) Adjust the track tension as outlined in paragraph 103 b.

d. Equipment.

BLOCK, wood

HANDLE, ratchet

BRACKET, rear wheel tension spring release,
SD902748

JACK, floor
JACK, vehicle, SD903400
SOCKET, 9/16-in.

CHISEL

WRENCH, adjustable

HAMMER

WRENCH, 2 3/8-in., SD903856

HANDLE, jack, SD903401

e. Rear Wheel Crank Arm and Spring Removal.

(1) Remove the rear wheel by following the procedure outlined in subparagraph b above.

(2) Unlock the adjusting nut lock (chisel and hammer) and remove the lock nut and spindle adjusting nut (adjustable wrench).

(3) Slide the crank arm with spring off the support tube (fig. 95).

(4) To remove the tension spring, remove the 4 nuts (9/16-in. socket, and ratchet handle) and locks from the two U-bolts which hold the spring to the underside of the crank arm.

f. Rear Wheel Crank Arm and Spring Installation. Tools as listed in subparagraph d above.

(1) If removed previously, install the spring on the crank arm, making sure the spring center bolt fits into the recess of the spring seat on the crank arm.

LIGHT CARGO CARRIER T-15

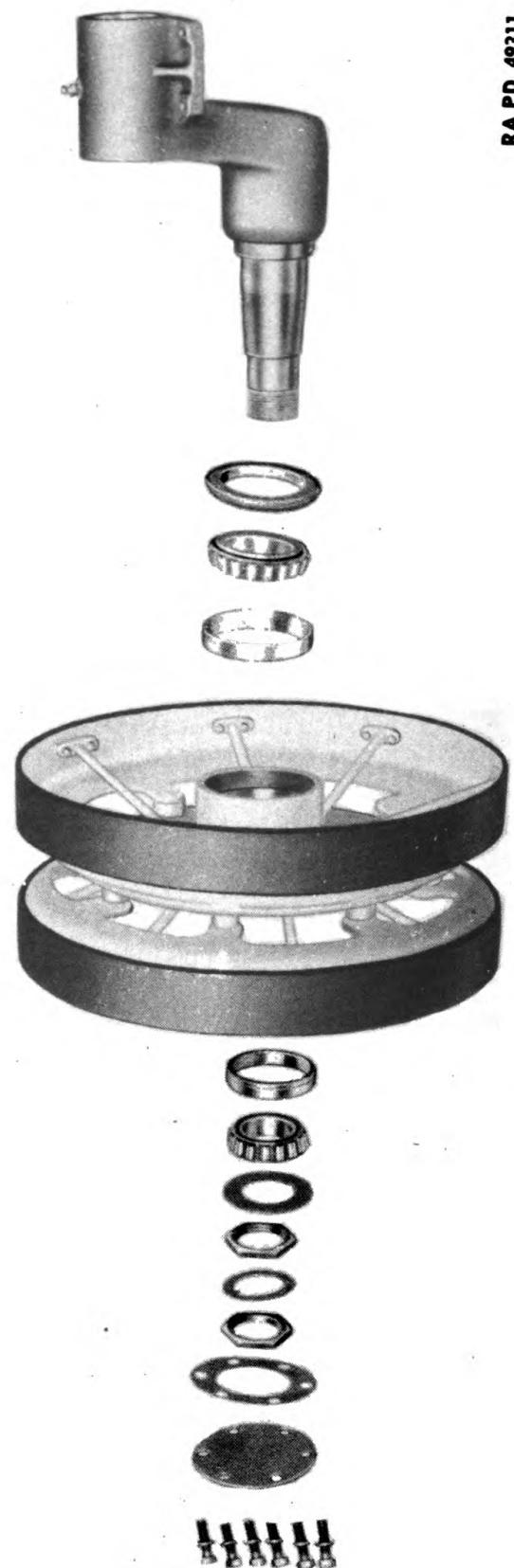


Figure 94—Crank Arm and Rear Wheel Parts

TRACKS AND SUSPENSIONS



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Figure 95—Rear Wheel Crank Arm and Spring Removal

(2) Coat the bronze bushings in the crank arm support tube bore with GREASE, general purpose, seasonal grade. Install the crank arm and spring assembly onto the support tube.

(3) Install the crank arm adjusting nut (adjustable wrench) and, after tightening it until the arm and spring move hard, back off the adjusting nut $\frac{1}{4}$ turn. Install the lock and lock nut and bend the ears of the lock (chisel and hammer).

(4) Complete the installation as directed under paragraph 104 e.

105. BOGIE WHEELS.

a. Equipment.

HAMMER

PUNCH, brass

HANDLE, jack, SD903401

PUNCH, drift

JACK, vehicle, SD903400

SCREWDRIVER

PLIERS

WRENCH, adjustable

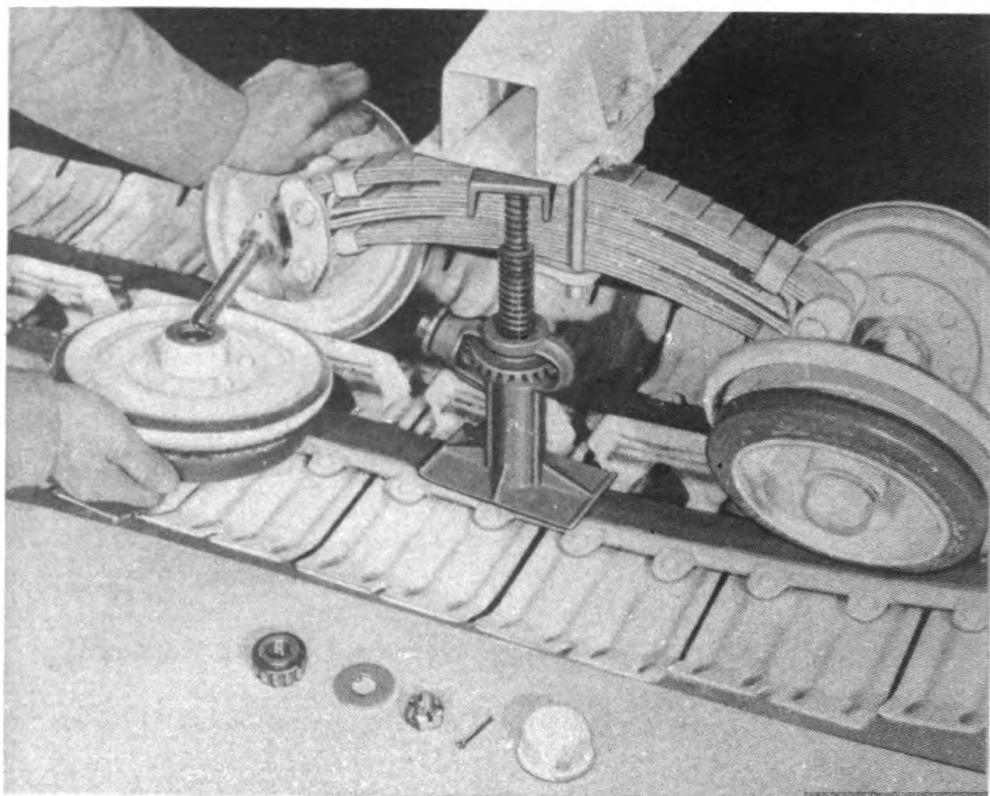
b. Removal.

(1) Relieve the vehicle's weight from the bogie wheel assembly by jacking between the bogie wheels carrier bracket and grouser plate (vehicle jack SD903400, and handle SD903401) until the wheel flange will clear the track belt band.

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(2) Pry the bogie wheel hub cap out of the hub (screwdriver and hammer).

(3) Take out the cotter pin (pliers) and remove the bogie wheel bearing adjusting nut (adjustable open-end wrench). Slip the wheel and bearings with oil seal off the bracket spindle (fig. 96).



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Figure 96—Bogie Wheel Removal

(4) Using a drift punch, tap out the inner oil seal and the inner bearing. Thoroughly clean bearings in SOLVENT, dry-cleaning.

(5) If the bearing cups are to be removed also, use a brass punch and hammer to carefully extract both cups.

c. Installation.

Tools as listed in subparagraph a above.

REPLACER, bogie wheel bearing, HKM-J270, disk 18, handle 1.

(1) Clean thoroughly the inside of the bogie wheel hub and install the bearing cups (bogie wheel bearing replacer HKM-J270, disk 18 and handle 1).

(2) Pack the inner bearing with GREASE, general purpose, seasonal grade, and install the inner bearing and a new oil seal.

(3) Pack the outer bearing with GREASE, general purpose, seasonal grade; place a supply of grease in the hub, and install the wheel while making sure that the inner flange of the wheel is inside the track belt.

TRACKS AND SUSPENSIONS

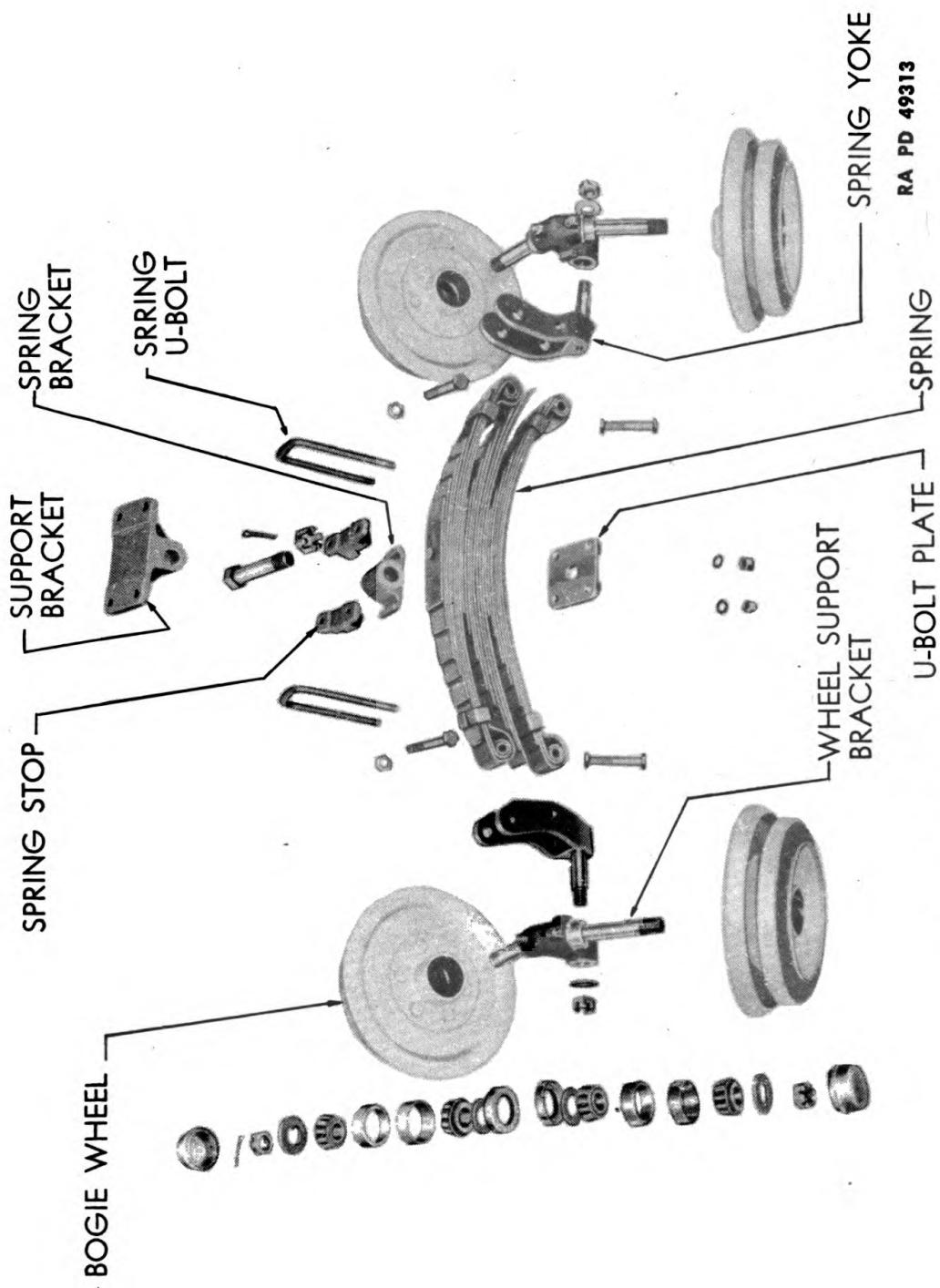


Figure 97—Bogie Wheels and Suspension Parts

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(4) With the wheel, outer bearing cone, and washer in place, install the adjusting nut and adjust the bearings (adjustable wrench) until the bogie wheel is hard to turn. Then back off the adjusting nut $\frac{1}{16}$ turn to free the bearings.

(5) Install a new cotter pin in the adjusting nut (pliers), install the hub cap, and remove the jack.

d. Bogie Assembly Removal.

BLOCK, wood

PLIERS

HANDLE, ratchet

SOCKET, $\frac{9}{16}$ -in.

JACK, floor

WRENCH, open-end, $\frac{9}{16}$ -in.

(1) Block up under the vehicle where the bogie set is to be removed.

(2) Remove the 4 cotter pins (pliers) bolts ($\frac{9}{16}$ -in. open-end wrench) and nuts ($\frac{9}{16}$ -in. socket, and ratchet handle) with locks which hold the bogie assembly to the support bracket on the hull.

(3) Lift the bogie assembly off the track belts and away from the vehicle.

e. Bogie Assembly Installation. Tools as listed in subparagraph a above.

Reverse the removal procedure to install the bogie assembly, noting that the spring travel stops, which are to be bolted on below the bogie mounting bracket, must be installed with the edge having the greater thickness toward the middle of the spring. On the front assemblies, the spring yoke which allows a higher mounting of the spring end must be installed to the front of the vehicle. On the rear assemblies, the stop on the bogie wheel spindle bracket permitting the greater tilt of the wheels goes to the front of the vehicle.

f. Bogie Spring Removal.

BLOCK, wood

SCREWDRIVER

HANDLE, ratchet

SOCKET, $\frac{9}{16}$ -in.

JACK, floor

SOCKET, $\frac{3}{4}$ -in.

PLIERS

SOCKET, $1\frac{5}{16}$ -in.

(1) Remove the bogie assembly as directed in subparagraph b above.

(2) Take out the cotter pin (pliers) and remove the spring yoke nut ($1\frac{5}{16}$ -in. socket, and ratchet handle) and flat washer. Pull the wheel spindle bracket with wheels off the spring yoke.

(3) Repeat step (2) to remove the bogie wheels and spindle off the spring yoke at the other end.

(4) At each spring end, loosen and remove the 2 shackle bolt lock nuts and bolts ($\frac{3}{4}$ -in. socket, and ratchet handle) which secure the spring end to the yoke.

(5) Remove the 4 spring clip (U-bolt) nuts ($\frac{9}{16}$ -in. socket, and ratchet handle) and star washers. Pry the spring plate off the clips (screwdriver) and pull the clips and cradle bracket off the spring.

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g. **Bogie Spring Installation.** Tools as listed in subparagraph d.

Reverse the removal steps given in paragraph 96 f to install a bogie spring. Make certain that the spring center bolthead enters the recess in the cradle bracket. The spring shackle bolts should be coated with GREASE, general purpose, seasonal grade; installed, and tightened snugly but not sufficiently to spring the yoke. Install the lock nuts and tighten them securely. The stop on the bogie wheel spindle bracket must be installed toward the end of the spring after the yoke pin and spindle hole are coated with GREASE, general purpose. Tighten the castellated nut holding the spindle bracket to the yoke until it hits the stop on the yoke pin and install a new cotter pin.

106. GUIDE WHEELS.a. **Equipment.**

BLOCK, wood	HANDLE, ratchet
BRACKET, rear wheel tension spring release, SD902748	JACK, vehicle, SD903400
HAMMER	PUNCH, brass
HANDLE, jack, SD903401	SCREWDRIVER
	SOCKET, $\frac{9}{16}$ -in.

b. **Removal.**

(1) Relieve the track tension as directed in paragraph 103 a (5) and lift the track guide lugs clear of the guide wheel flanges.

(2) Remove the 4 hub cap screws with lock washers (screwdriver) and the guide wheel hub cap. Remove the wheel retaining spindle screw ($\frac{9}{16}$ -in. socket extension, and ratchet handle), lock, flat, and thrust washer. Pull off the guide wheel including needle bearings and oil seal (fig. 98).

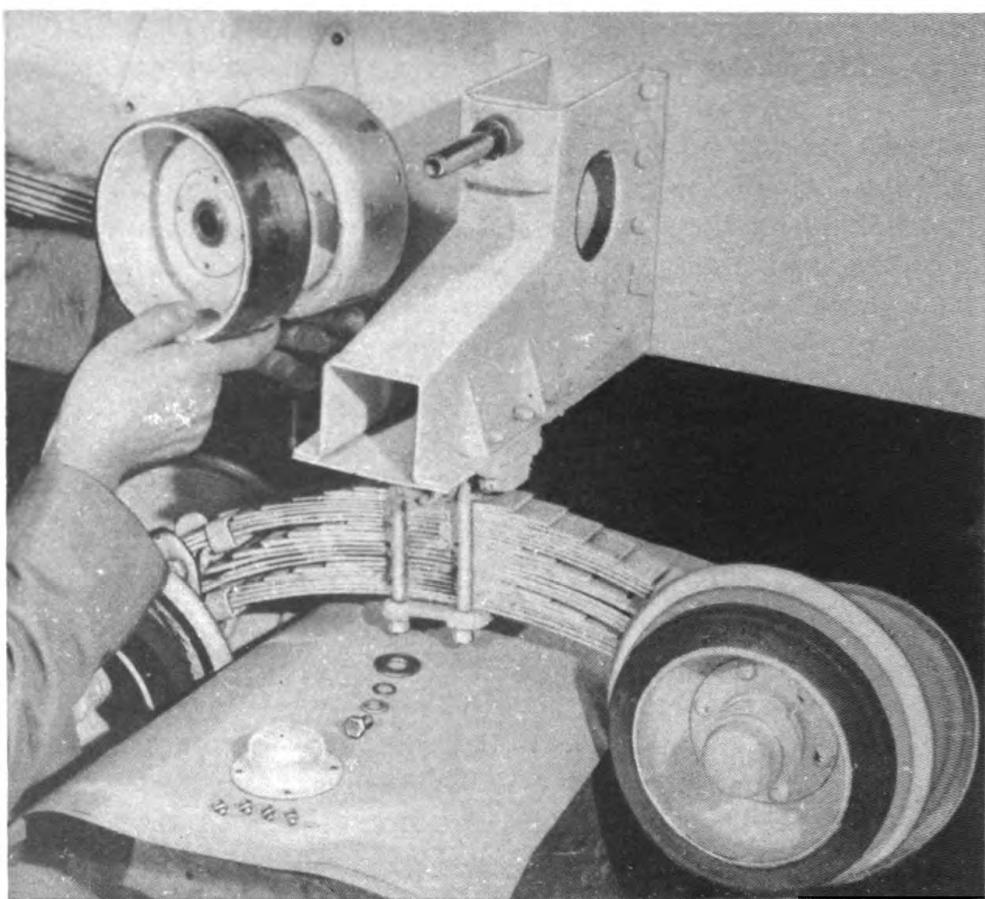
(3) Remove the 4 screws (screwdriver) which hold the inner wheel oil seal cap to the guide wheel and lift off the cap with seal. When installing a new cap seal, use a new gasket between the cap flange and wheel.

(4) If necessary, the 2 needle-type bearings at each end of the guide wheel hub may be removed with a brass punch and hammer, tapping carefully at successive points around the bearing. Clean the bearings and wheel hub in SOLVENT, dry-cleaning.

c. **Installation.** Tools as listed in subparagraph a above.

No special instructions are required to install the guide wheel. In reversing the removal procedure, pack the needle bearings with GREASE, general purpose, seasonal grade; press them into the wheel hub (wooden blocks and hammer) so that they are flush with the hub ends.

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Figure 98—Guide Wheel Removal

Install a new cap oil seal with gasket before placing the guide wheel on the spindle. Proper end play is provided in the design of the wheel and spindle; therefore, tighten the wheel retaining spindle screw securely.

107. GROUSER PLATES.

a. Each of the 41 grouser plates is held to the 2-track belt bands by 8 rivets. If the plates are damaged or for any reason require replacement, the condition must be reported to ordnance personnel so that the work involving riveting will be performed.

b. Auxiliary grousers are available for attachment to the track grouser plates to provide better traction during vehicle operation over fine and deep snow. These supplementary grousers are easily installed on every other track plate as follows:

(1) Hook the fixed notch end of the grouser over the inner end of the plate.

TRACKS AND SUSPENSIONS

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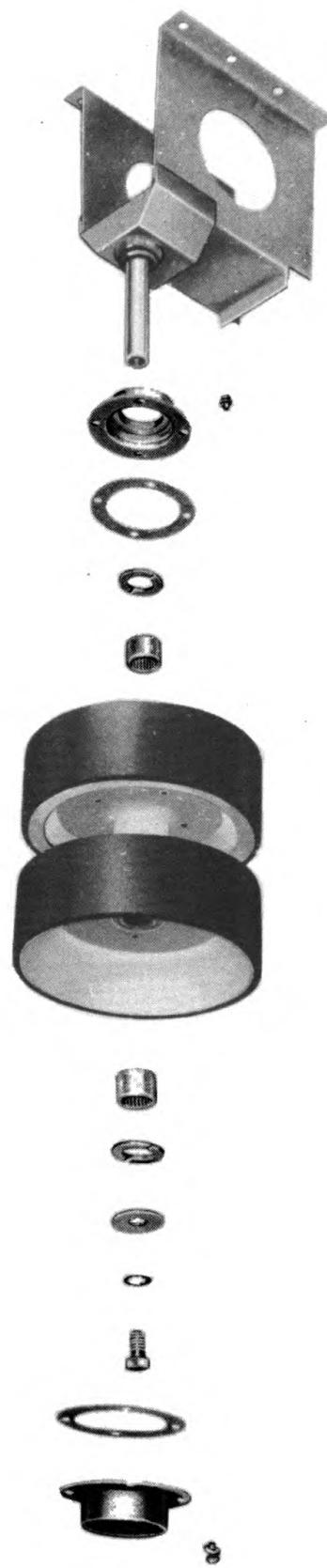
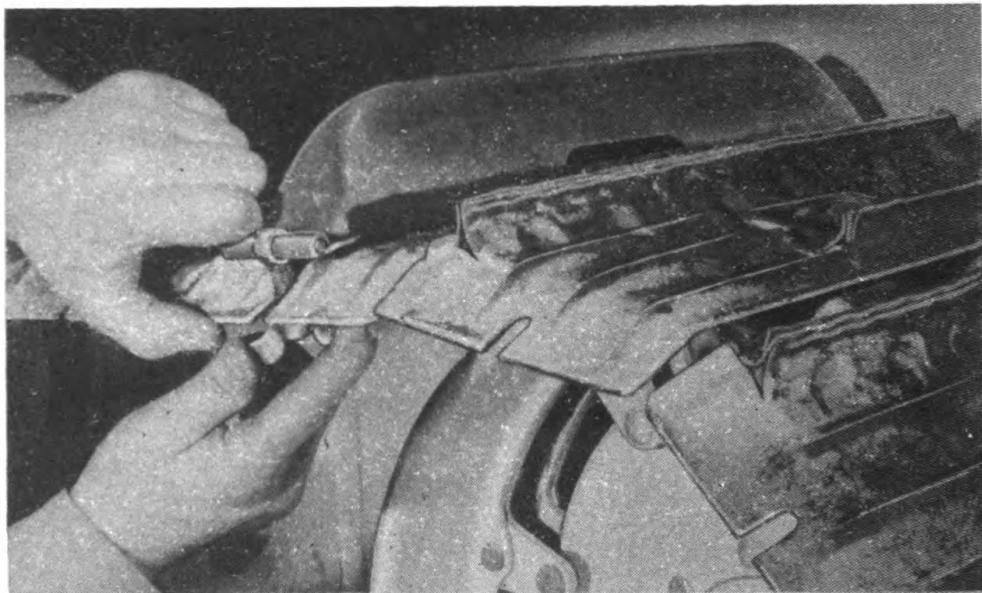


Figure 99—Guide Wheel, Wheel Bearings and Bracket

LIGHT CARGO CARRIER T-15

(2) Loosen the wing nut on the adjustable end of the auxiliary grouser and slip the wing nut with washer over the plate outer end so that the threaded bolt enters the notch in the plate. Tighten the wing nut (fig. 100).



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Figure 100—Detachable Grouser Installation

Section XXI

INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES

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108. GENERAL DESCRIPTION.

- a. The electrical system of this vehicle is of the single wire grounded type. It consists of a heavy-duty battery, a belt driven generator, a starting motor, a current and voltage regulator, the wiring system, and the various electrical accessories. The starting motor and generator are discussed in section XIII. Since one of the items of the vehicle equipment is a radio, adequate grounding is extremely important and is provided at all points where grounds are necessary. All connections throughout the system must be kept clean and tight.

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b. Throughout this section, the face of the instrument panel or gages as observed from the driver's seat will be referred to as the front. References to the rear or back of the panel or instruments relate to the side at which the mountings and electrical terminals are located.

109. BATTERY.

a. The electrical system employs a 12-volt, 6-cell, 19-plate, 153-ampere hour (20-hour rate) battery. The battery is located on a shelf in the engine compartment, slightly above and to the left of the engine. The battery is separated from the engine compartment by a sheet steel, insulated partition, and a removable insulated cover. The battery is installed with the open terminals to the front. In this position the negative post is toward the engine with the positive post at the left or hull side. The negative post is grounded to the front frame of the battery compartment by means of a flexible, lead coated, copper braid strap. The battery compartment is heated by a coil carrying warm fluid piped under pressure from the engine cooling system (par. 78). In addition, dissipation of engine compartment heat from the outside of the hull adjacent to the battery is retarded by the presence of the engine exhaust muffler located on the vehicle deck, just above and to the left of the battery compartment. It is important that the battery temperature be kept as high as possible if it is to function efficiently.

b. Equipment.

EXTENSION, socket

SOCKET, $\frac{1}{2}$ -in.

HANDLE, ratchet

WRENCH, open-end, $\frac{7}{16}$ -in.

HYDROMETER, battery,

(2)

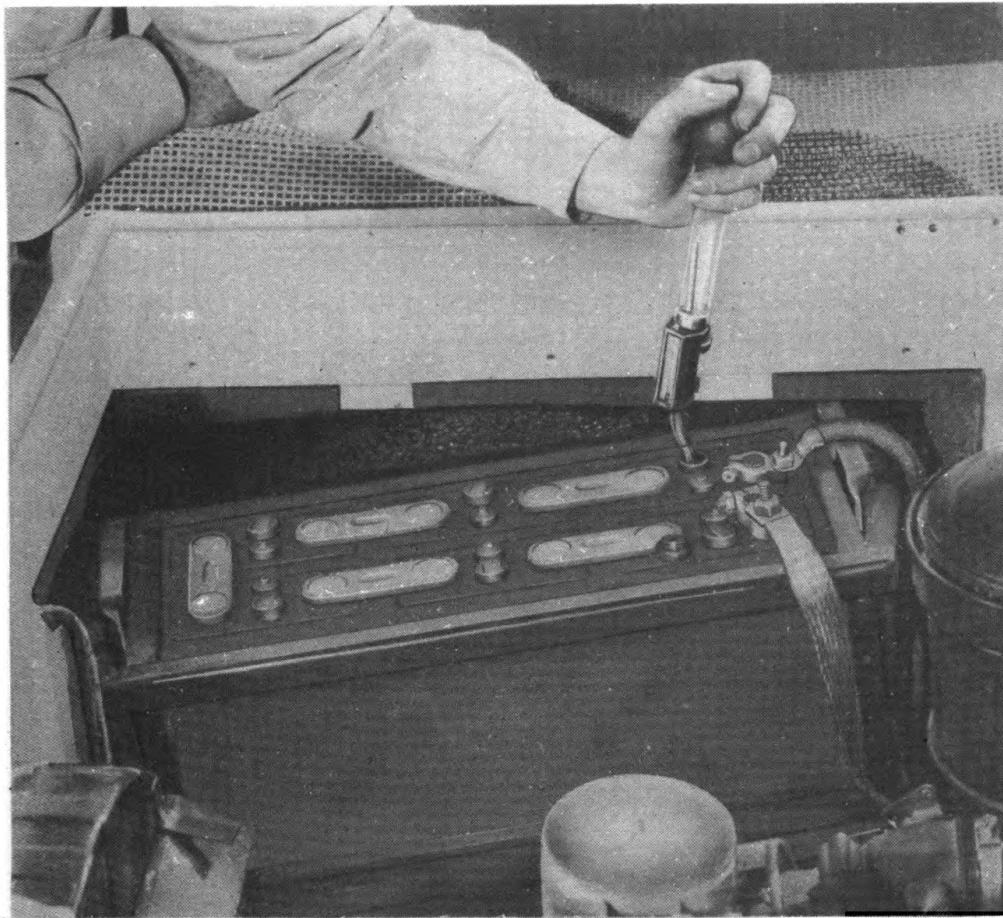
EDL40

c. Checking and Servicing.

The specific gravity of the battery electrolyte fluid should be checked once each week (fig. 101). To do this it is necessary to remove the battery compartment cover, using two $\frac{7}{16}$ -inch open-end wrenches at the 2 bolts, nuts, flat washers, and lock washers holding the cover to the rear deck coaming and a $\frac{1}{2}$ -inch socket extension, and ratchet handle to remove the remaining 7 cap screws. After checking the battery electrolyte with hydrometer EDL40 and if the condition of the battery is found to be satisfactory, the battery cells should be filled to level with distilled water (fig. 102). When the hydrometer test of the battery shows a corrected reading of 1280 or more, the battery is satisfactory. If the reading is appreciably less than 1280 the battery should be removed and replaced with a freshly charged battery. To avoid overfilling and to insure getting the proper amount of water in each cell, each filler plug should be pressed firmly on the cell vent directly opposite each filler hole. If the distilled water is added until the water level reaches the ^{original} ~~filler~~ opening

INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES

throat, the level will be exactly correct when the filler plug for that cell is removed from the vent and installed in the filler hole. After filling the battery, always wipe off any water spilled and see that the terminals are clean and tight.



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Figure 101—Checking Battery With Hydrometer—EDL40

d. Removal.

PLIERS

WRENCH, open-end, $\frac{5}{8}$ -in.

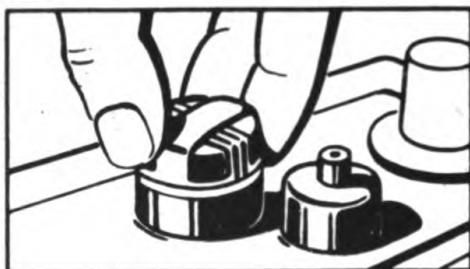
WRENCH, box, $\frac{1}{16}$ -in.

(1) Remove the cover as directed in subparagraph **c** above, which gives the procedure for checking specific gravity.

(2) Loosen the battery cable terminal clamp nuts ($\frac{1}{16}$ -in. box wrench). Loosen the clamps on the battery posts (pliers) and remove both the positive and negative battery cable terminals from the battery posts.

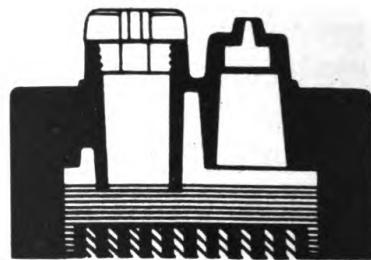
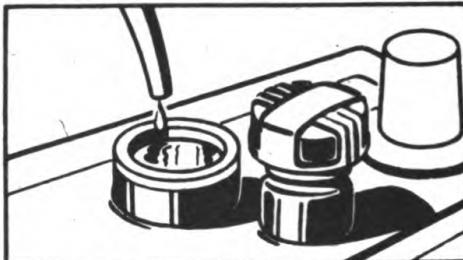
(3) Remove the hold down clamp frame nut at each end of the battery ($\frac{5}{8}$ -in. open-end wrench) lift off the frame, and lift the battery out of the battery compartment.

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1. Remove filler-cap.

2. Place cap on safety-vent forming air lock in breather-chamber.



3. Fill well with distilled water. Air lock prevents solution rising above bottom of well.

4. Remove cap from safety-vent and solution drops to correct level. Replace cap in filler hole.

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INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES

e. Installation. Tools as listed in subparagraph d above.

(1) Install the battery by reversing the removal procedure, making sure that the hold down frame nuts are tightened only enough to prevent battery movement. Also, make sure the connections are clean and secure. Spread a thin film of GREASE, general purpose (seasonal grade), over the battery posts and cable terminals to retard corrosion.

110. GENERATOR REGULATOR.

a. Description. Operating as one of the chief component parts of the electrical system is the generator regulator. It consists of three entirely independent units encased in a sealed, moisture and dirt proof box mounted on the engine side of the engine compartment bulkhead. The units within the box are: First, the circuit breaker which closes and opens the circuit between the generator and battery to prevent the current from flowing back through the generator when the engine is stopped. Second, the current-limiting regulator which controls the maximum output of the generator and prevents damage to the generator and battery. Third, the voltage regulator which holds the electrical system voltage constant within close limits under the various operating conditions.

b. Servicing. If at any time the voltage and current regulator is believed to be at fault, disconnect, remove, and replace the unit with a new or reconditioned regulator.

c. Equipment.

EXTENSION, socket

SOCKET, 1/2-in.

HANDLE, ratchet

WRENCH, open-end, 1/2-in.

SCREWDRIVER

d. Removal.

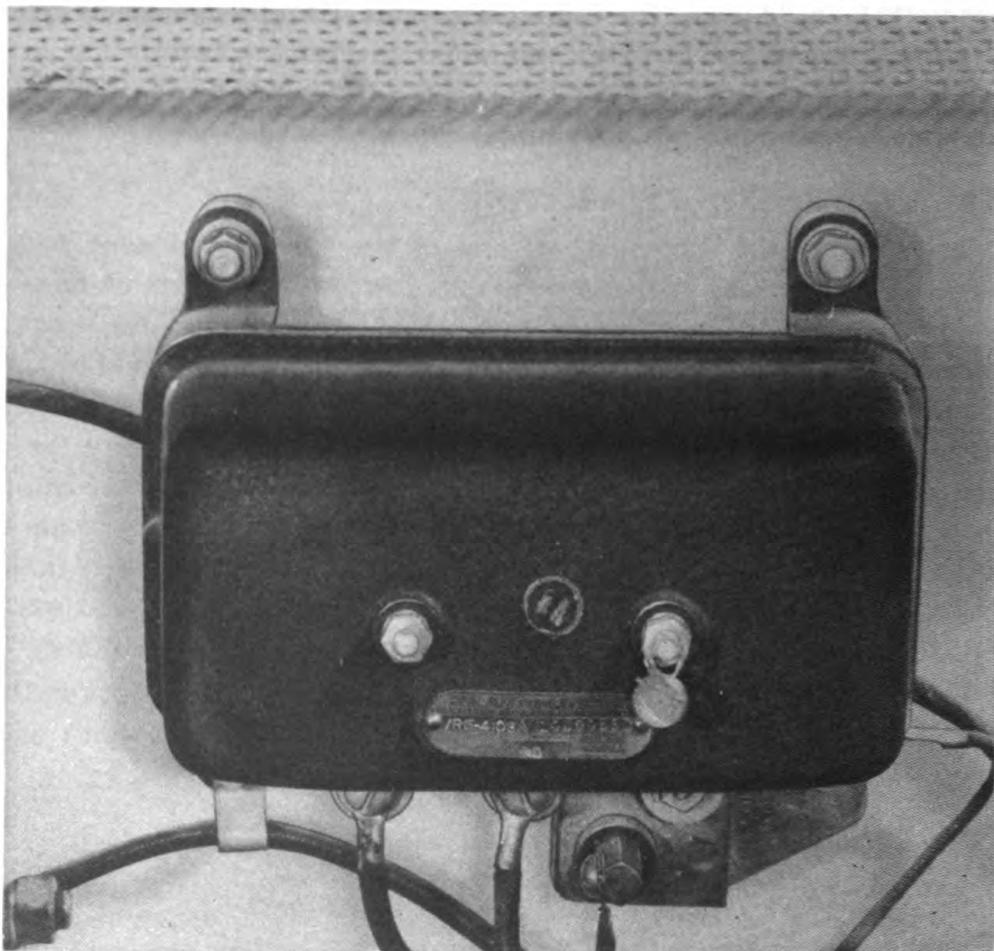
(1) Open the engine compartment lid, remove the battery compartment cover, and disconnect the battery (par. 55 g).

(2) Disconnect the 4 wires at the regulator (screwdriver), noting carefully that the heavy black wire connects at the left post, the oak wire to the post next to it, the small black wire to the filter post, and the red wire to the base (fig. 103).

(3) Remove the 4 mounting bolts which attach regulator to bulkhead (1/2-in. open-end wrench), nuts (1/2-in. socket extension, and ratchet handle), flat washers, lock washers, and star washers (noting that the star washers are installed between the regulator legs and the bulkhead). Lift the regulator off the bulkhead and away from the vehicle.

e. Installation. Tools as listed in subparagraph c above.

(1) Reverse the removal instructions making certain the regulator is mounted properly and connected exactly as indicated in paragraph 110 d (2).



RA PD 49349

Figure 103—Generator Regulator Installed on Bulkhead

111. STARTER SOLENOID SWITCH.

a. **Description.** As explained in connection with the starting motor (par. 65 a), the solenoid switch functions to close starting motor circuit when the starter switch push button on the instrument panel is operated. On depressing the button, an electric magnet in the solenoid switch becomes energized to draw heavy copper contacts together and thus close the starting motor circuit to set the starter in motion. The solenoid switch is mounted on the engine compartment side of the bulkhead just to the left of the generator regulator. An emergency starter switch button is located on the top of the solenoid switch under a screw cap (fig. 104).

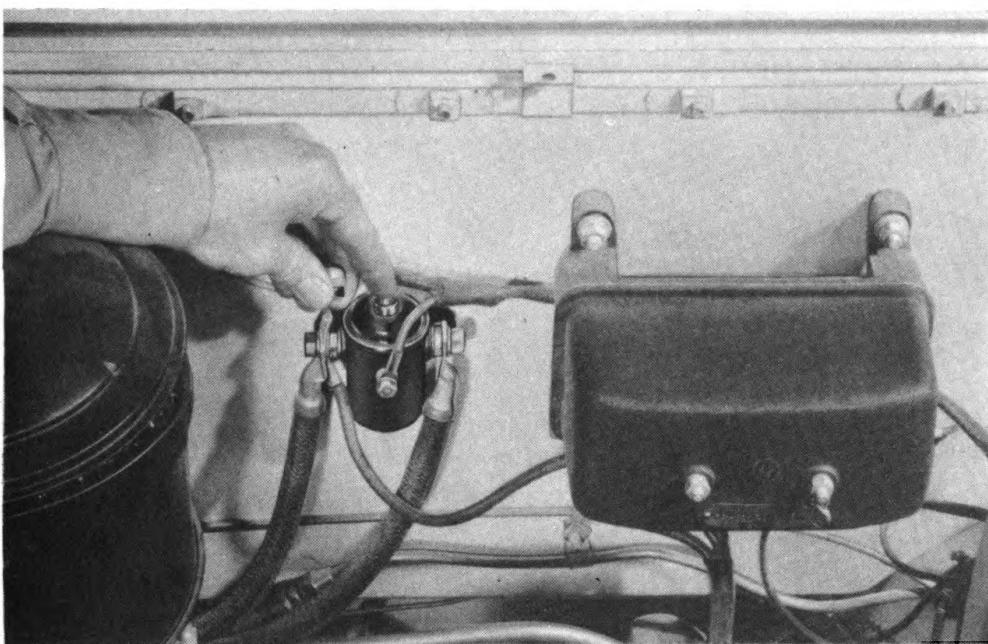
b. **Equipment.**

SCREWDRIVER

WRENCH, open-end, $\frac{3}{8}$ -in.

WRENCH, open-end, $\frac{1}{2}$ -in.

INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES



RA PD 49347

Figure 104—Operating Solenoid Emergency Starter Switch

c. Removal.

(1) Open the engine compartment lid, remove the battery compartment cover, and disconnect the battery as directed in paragraph 55 g.

(2) Remove the left terminal nut (1/2-in. open-end wrench) and disconnect the battery cable, heavy red wire, and black wire. Remove the switch rear terminal nut (3/8-in. open-end wrench) and disconnect the oak wire fastened at this point. Disconnect the starting motor cable from the right-hand terminal after removing the terminal nut (1/2-in. open-end wrench).

(3) The solenoid switch is removed from the bulkhead by removing the 2 mounting screws (screwdriver), the heads of which are on the forward side of the bulkhead, and nuts (3/8-in. open-end wrench) with lock and flat washers.

d. Installation. Tools as listed in subparagraph b above.

The solenoid switch is installed by reversing the procedure followed for removal. Note that the battery cable, heavy red wire, and black wire, connect to the left switch terminal, the oak wire to the rear post, and the starting motor cable to the switch right-hand terminal post.

112. STARTER SWITCH.

a. Description. The starter switch is mounted on the left side of the instrument panel and acts to energize the starter solenoid switch.

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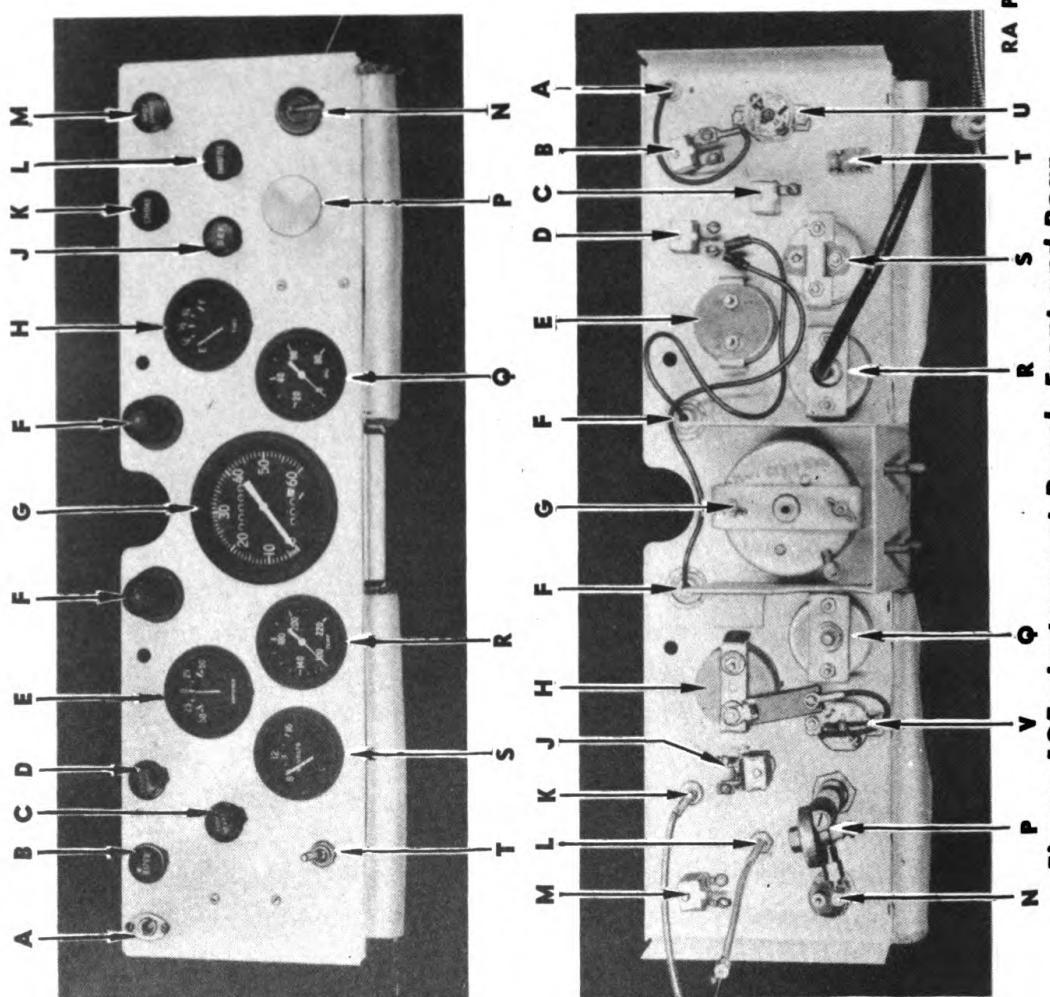


Figure 105—Instrument Panel—Front and Rear

INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES

- A — WINDSHIELD WIPER PANEL SOCKET
- B — WINDSHIELD WIPER SWITCH
- C — STARTER PUSH BUTTON
- D — INSTRUMENT PANEL LAMPS AND REAR MARKER LAMP SWITCH
- E — AMMETER
- F — INSTRUMENT PANEL LAMP
- G — SPEEDOMETER
- H — FUEL GAGE
- J — WINDSHIELD DEFROSTER SWITCH
- K — CARBURETOR CHOKE CONTROL
- L — CARBURETOR THROTTLE CONTROL
- M — SPOT LAMP SWITCH
- N — IGNITION SWITCH
- P — PRIMER
- Q — OIL PRESSURE GAGE
- R — ENGINE HEAT INDICATOR
- S — VOLTMETER
- T — VOLTMETER AND COMPASS LAMP SWITCH
- U — LAMPS AND WINDSHIELD WIPER CIRCUIT BREAKER
- V — FUEL GAGE CIRCUIT BREAKER

RA PD 49341B

Legend for Figure 105—Instrument Panel—Front and Rear

LIGHT CARGO CARRIER T-15

when the button is pushed in with the ignition switch turned on (fig. 105 (c)).

b. Equipment.

SCREWDRIVER

WRENCH, box, $\frac{9}{16}$ -in.

SCREWDRIVER, small instrument

c. Removal.

- (1) Disconnect the battery ground strap (par. 55 n).
- (2) On the back of the switch, loosen the terminal post screw (screwdriver) and pull off the brown wire having the spade type terminal end.
- (3) Loosen the button set screw (small instrument screwdriver) and remove the button by turning it counterclockwise off the switch operating shaft.
- (4) Remove the lock nut ($\frac{9}{16}$ -in. box wrench) which holds the switch body to the instrument panel. Remove the switch from the rear side of the panel noting that a star washer is used between the switch body and instrument panel.

d. Installation. Tools as listed in subparagraph b above.

Reverse the steps given for removal of the starter switch, making sure a star washer is installed between the switch body and back of the instrument panel. Install the switch button by turning it clockwise on the operating shaft until tight; then back it off until the identification name is horizontal and tighten the set screw in the button.

113. IGNITION SWITCH.

a. Description. The ignition switch is located on the right side of the instrument panel (N, fig. 10). This lever type switch must be turned to its on position (clockwise) before the engine will fire. In addition, the electric fuel gage will not register unless the ignition switch is turned on.

b. Equipment.

HANDLE, T-socket

SOCKET, midget, $1\frac{1}{3}_2$ -in.

PLIERS

c. Removal.

- (1) Disconnect the battery ground straps (par. 55 n).
- (2) Remove the 2 terminal post nuts ($1\frac{1}{3}_2$ -in. midget socket, and T-handle) and locks on the back of the switch and remove the black wire from the top terminal post and the 2 black and green wires from the bottom post.
- (3) Remove the escutcheon nut (pliers) on the panel face and pull the switch body out from the back of the instrument panel.

d. Installation. Tools as listed in subparagraph b above.

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To install the ignition switch reverse the removal instructions, connecting the black wire to the top terminal post and the 2 black and green wires to the bottom post.

114. AMMETER.

a. **Description.** The ammeter is located on the left side of the instrument panel (E, fig. 105). It registers the rate of electrical charge to or discharge from the battery. The instrument has a 50-ampere range both for charge and discharge. With all electrical switches in their "OFF" positions the ammeter hand should stand at zero. If a reading appears under these conditions, report the matter to ordnance personnel so that the electrical short or difficulty can be traced and eliminated. If the ammeter is found to be defective it should be replaced.

b. **Equipment.**

WRENCH, open-end, $\frac{3}{8}$ -in.

c. **Removal.**

- (1) Disconnect the battery ground strap (par. 55 n).
- (2) Remove the 2 terminal post nuts ($\frac{3}{8}$ -in. open-end wrench) and locks from the back of the gage and pull the red wire off the left post and the 2 black wires from the right terminal.
- (3) Remove the 2 nuts ($\frac{3}{8}$ -in. open-end wrench) and flat washers which hold the clamp bracket to the ammeter. Remove the clamp with fiber disk, and insulators from the 2 instrument terminal posts. Slip the ammeter out the mounting hole in the instrument panel face.

d. **Installation.** Tools as listed in subparagraph 114 b above.

Reverse the removal operations, noting that the locating boss on the bottom of the gage fits into a recess in the panel hole. Make sure the red wire is connected to the left terminal and the 2 black wires to the right post.

115. VOLTMETER AND SWITCH.

a. **Description.** The voltmeter and switch are located on the left side of the instrument panel (S, fig. 105). The voltmeter registers the voltage present in the electrical system. This instrument has an 8- to 16-volt range. It is necessary to snap on the voltmeter switch in order to take a voltage reading or light the bulb at the face of the compass.

b. **Equipment.**

WRENCH, open-end, $\frac{3}{8}$ -in.

c. **Voltmeter Removal.**

- (1) Remove the nut ($\frac{3}{8}$ -in. open-end wrench) and lock and disconnect the black wire from the lower terminal post on the back of the voltmeter.

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(2) Remove the 2 nuts ($\frac{3}{8}$ -in. open-end wrench) and locks from the studs on the voltmeter which hold the clamp bracket to the instrument panel and the red wire at the left mounting stud. Pull the bracket off the studs and slip the voltmeter out the panel face opening.

d. **Voltmeter Installation.** Tools as listed in subparagraph **b** above.

Install the voltmeter by reversing the directions given for removal.

e. **Switch Removal.**

SCREWDRIVER

WRENCH, box, $\frac{9}{16}$ -in.

(1) Disconnect the battery ground strap (par. 55 **n**).

(2) Loosen the 2 terminal screws (screwdriver) and remove the 2 black wires from the lower post and the red wire from the upper terminal at the back of the switch.

(3) Remove the escutcheon nut ($\frac{9}{16}$ -in. box wrench) and ring from the front of the switch. Push the switch body out the panel opening.

f. **Switch Installation.** Tools as listed in subparagraph **e** above.

(1) If a new switch is to be installed, transfer the jam nut onto the new switch body and adjust the nut so that the switch body will be flush with the escutcheon nut when tight.

(2) Reverse the removal steps to complete the installation, connecting the 2 black wires to the lower post and the red wire to the upper terminal.

116. FUEL GAGE AND CIRCUIT BREAKER.

a. **Description.** The electric fuel gage is mounted on the right side of the instrument panel (H, fig. 105). The gage is calibrated in quarters so that the contents of the tank (25-gal capacity) may be approximated. The instrument registers during engine operation. If the engine is not running, it is necessary to turn the ignition switch to its "ON" position before taking a reading. The gage is wired to a float unit on the fuel tank (par. 68 **d**). A circuit breaker is mounted on the gage and in the circuit.

b. **Equipment.**

WRENCH, open-end, $\frac{3}{8}$ -in.

c. **Fuel Gage Removal.**

(1) Remove the 2 terminal post nuts ($\frac{3}{8}$ -in. open-end wrench) and locks on the back of the gage. Disconnect the black and red wire from the left post and the resistance unit from the right terminal.

(2) Remove the 2 clamp nuts ($\frac{3}{8}$ -in open-end wrench) and the gage clamp bracket. Pull the gage out of the instrument panel hole.

d. **Fuel Gage Installation.** Tools as listed in paragraph 116 **b**.

Reverse the removal operations to install the gage, making sure the black and red wire is connected to the left terminal and the resistance unit to the right post.

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e. Circuit Breaker Removal.

SCREWDRIVER

WRENCH, open-end, $1\frac{1}{3}_2$ -in.

(1) While holding the 2 nuts mounting the circuit breaker to the back of the instrument panel ($1\frac{1}{3}_2$ -in. open-end wrench), remove the 2 mounting screws (screwdriver) the heads of which are on the face of the instrument panel. Lift the circuit breaker off the mounting screws (V, fig. 105).

(2) Remove the 2 terminal post screws (screwdriver) and disconnect the black wire from the upper post and the black and green wire from the lower post.

f. Circuit Breaker Installation.

Tools as listed in subparagraph e above.

(1) Reverse the removal directions, making sure the breaker is installed with the terminal posts to the right. Connect the black and green wire to the lower terminal and the black wire on the upper post.

117. SPOTLIGHT SWITCH.

a. **Description.** The spotlight switch is located in the upper right-hand corner on the instrument panel (M, fig. 105). The switch is of the push-pull type and operates the spot lamp only.

b. Equipment.

SCREWDRIVER

SCREWDRIVER, small, instrument

WRENCH, box, $\frac{9}{16}$ -in.

c. Removal.

(1) Disconnect the battery ground strap (par. 55 n).

(2) Loosen the 2 terminal screws (screwdriver) on the back of the switch and remove the silver wire spade terminal from the right post and the black wire from the left post.

(3) Loosen the switch button set screw (small instrument screwdriver) and remove the button from the operating shaft by turning the button counterclockwise.

(4) Remove the switch body to panel lock nut ($\frac{9}{16}$ -in. box wrench) and lift the switch out of the panel hole. Note that a star washer is used between the switch body and the back of the instrument panel.

d. Installation. Tools as listed in subparagraph b above.

The spotlight switch is installed in the reverse manner of removal. The star washer must be installed between the switch body and the back of the panel. When installing the switch button, turn it clockwise on the shaft until tight; then turn the button until the identification name is horizontal and tighten the set screw. The silver wire is connected at the right terminal screw and the black wire to the left terminal.

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118. SPOTLIGHT.

a. **Description.** The spotlight is mounted near the front on the right deck of the vehicle on a ball socket which permits adjustment of the light over a wide frontal range by the driver while within the cockpit. A white canvas cover with fastening cords protects the light lens when the light is not in use.

b. Equipment.

HANDLE, ratchet

WRENCH, box, $\frac{7}{8}$ -in.

SCREWDRIVER

WRENCH, open-end, $\frac{7}{16}$ -in.

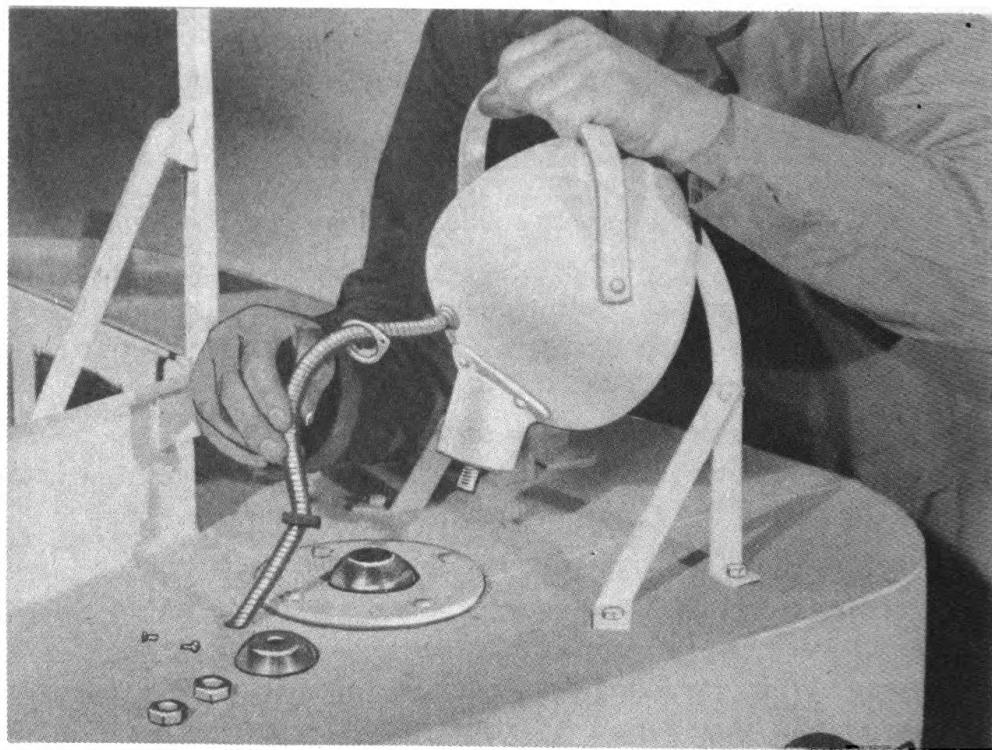
WRENCH, box, $\frac{7}{16}$ -in.

c. Removal.

(1) Loosen the post screw (screwdriver) at the rear right side of the spotlight switch and disconnect the silver wire spade terminal from the post. Remove the light cable clip nut from the light base bolts ($\frac{7}{16}$ -in. box and $\frac{7}{16}$ -in. open-end wrenches) and spread the cable clip at the underside of the light base bolt and remove the cable from the clip.

(2) Remove the lock nut ($\frac{7}{8}$ -in. box wrench) on the light to base bolt. Pull the light up and off the base, noting that the ball joint top washer is free as the light and fastening bolt are pulled upward (fig. 106).

(3) Remove the 2 metal screws (screwdriver) which secure the metal



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Figure 106—Spotlight Lamp Removal

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rubber grommet cap to the deck. Pull the cap and grommet off the end of the cable. (If a new light and cable assembly is to be installed, the cap and grommet must be transferred to the new cable. Install the grommet crowned side to the top.)

d. Installation. Tools as listed in subparagraph b above.

Reverse the removal procedure to install the spotlight. Make sure by test while tightening the base bolt nut that the light is sufficiently rigid to prevent changing position during operation over rough terrain.

e. Removal of Light Bulb and Reflector for Servicing.

PLIERS

WRENCH, open-end, $\frac{7}{8}$ -in.

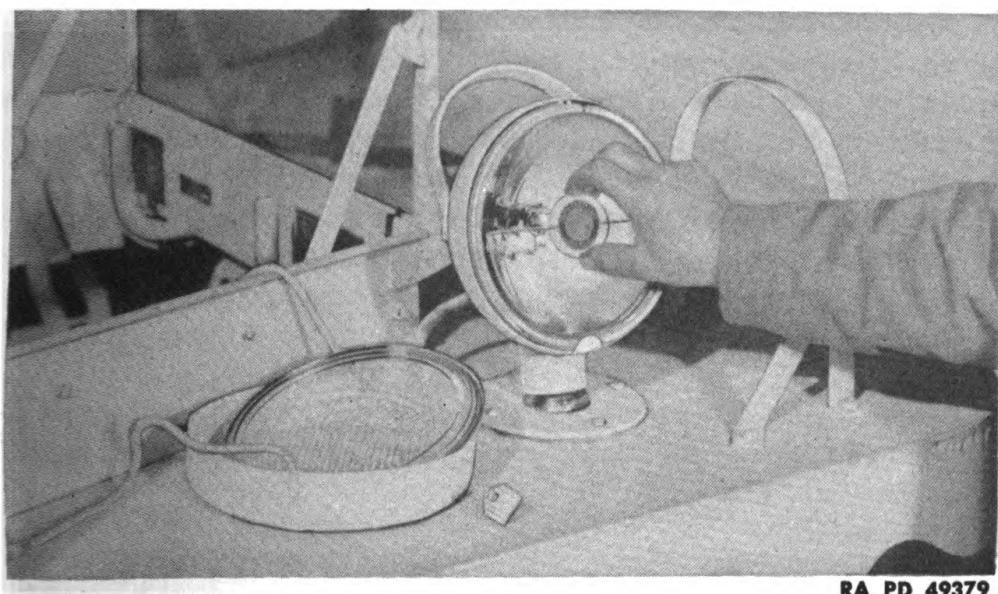
SCREWDRIVER

(1) Remove the screw (screwdriver) and rim lug at the top of the light rim. Pull the rim pins together (pliers) to spring the lens retaining ring out of the light body and lower lug on the body. Lift the lens out of the body.

(2) If only the lamp bulb is to be replaced, push it inward, turn it counterclockwise, then pull it outward and up to clear the diffuser plate (fig. 107) (bulb—C3, 102 $\frac{1}{2}$ cp., 12-16 v.).

(3) If the deflector and reflector are to be removed, pull the deflector, reflector, and the bulb assembly outward at the top and lift the assembly up and out. Remove the brass nut (pliers) holding the light wire terminal in the bulb socket. Remove the deflector, reflector, and bulb assembly from the body.

(4) At the rear of the reflector, remove the nut ($\frac{7}{8}$ -in. open-end wrench) and star washer. Pull the bulb with socket and the deflector



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from the reflector, noting that a spacer ring is used between the socket and reflector.

f. Installation of Light Bulb and Reflector. Tools as listed in subparagraph e above.

If only the bulb is replaced, install a new bulb by reversing the removal procedure. Likewise, if the bulb with socket, deflector, and reflector were removed, reverse the directions given for removal when installing the parts. To adjust the focusing of the light, the deflector, reflector, and the bulb assembly, as well as the nut and star lock, must be removed to set the adjusting screw just below the bulb location. This screw may be adjusted to change the final position of the cradled bulb socket axis.

119. REAR MARKER LIGHT.

a. Description. The blackout-type, rear marker light is mounted to a bracket on the vehicle deck coaming at the right rear corner of the engine compartment. The marker light is connected in the instrument panel lights' circuit and burns only when the panel lights switch is pulled out to its on position.

b. Equipment.

SCREWDRIVER

WRENCH, open-end, $\frac{9}{16}$ -in.

c. Removal.

(1) To remove the bulb only, remove the light door screw (screw-driver) near the bottom of the door and lift the door and rubber gasket out at the bottom and upward off the light body. Turn the bulb counter-clockwise and pull it out of the bulb socket (bulb 1247, 3 cp., 12-16 v).

(2) To remove the entire light assembly, pull the blue wire out of the Douglas terminal located just inside the right rear corner of the vehicle deck coaming. Pull the wire with covering loom through the hole in the coaming. Unscrew the ferrule at the light and slip the loom off the wire. Remove the light body to bracket nut ($\frac{9}{16}$ -in. open-end wrench) and star washer and lift the light assembly and wire out of the bracket hole.

d. Installation. Tools as listed in subparagraph 119 b above.

Reverse the removal procedure, making sure the star washer is installed between the light mounting nut and the underside of the mounting bracket.

120. INSTRUMENT PANEL LIGHTS SWITCH.

a. Description. This push-pull type switch is located on the left side of the instrument panel and controls the 2 instrument panel lights and the rear marker light (D, fig. 105).

b. Equipment.

SCREWDRIVER

WRENCH, box, $\frac{9}{16}$ -in.

SCREWDRIVER, small,
instrument

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c. Removal.

(1) Disconnect the battery ground strap (par. 55 n).

(2) Loosen the 2 terminal post screws (screwdriver) on the back of the switch body and remove the 2 green and the 1 blue wires from the right terminal and the orange wire from the left post.

(3) Loosen the switch button set screw (small instrument screwdriver) and turn the button counterclockwise off the switch operating shaft.

(4) Remove the lock nut ($\frac{9}{16}$ -in. box wrench) that holds the switch body to the instrument panel. Remove the switch from the rear side of the panel, noting the use of a star washer between the switch body and rear side of the panel.

d. Installation. Tools as listed in subparagraph b above.

Reverse the removal steps to install the switch, installing the star washer between the switch body and rear side of the panel, and connecting the 2 green and 1 blue wires to the right terminal and the orange wire to the left post. Install the switch button by turning it clockwise on the operating shaft until tight, then turn it until the identification name is horizontal and tighten the button set screw.

121. INSTRUMENT PANEL LIGHTS.

a. Description. Two lights are located near the middle of the instrument panel, above and to each side of the speedometer (F, fig. 105). These lights provide sufficient illumination to make all of the instruments and controls visible in darkness. The lights cannot be operated individually because they are connected to a single control switch which lights the rear marker light also.

b. Equipment.

SCREWDRIVER

c. Removal.

(1) With the hands, pull downward on the lamp assembly to spring the retaining spider loose from the panel.

(2) To remove the bulb, spring the bulb socket out of the body or shield by pulling sidewise on the wire. Push in on the bulb, turn it counterclockwise, and pull it out of the socket (bulb-53 1 cp., 12-16 v.).

(3) If it is necessary to replace the entire light assembly or the wire, disconnect the proper green wire from the right terminal of the lamp switch (par. 120 b (2)) before removing the light assembly from the panel.

d. Installation. Tools as listed in subparagraph b above.

Depending on the extent of the removal operations performed, reverse the steps to install the instrument light on the panel. Make sure the green

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wire from the light is connected to the right-hand terminal of the light switch.

122. CIRCUIT BREAKER (LIGHTS AND ELECTRIC WINDSHIELD WIPER).

a. **Description.** The circuit breaker connected in the lights and electric windshield wiper circuit functions to prevent damage to the wiper motor or wiring in the event of an electrical short or overload. This breaker is mounted on the left back side of the instrument panel (V, fig. 105).

b. **Equipment.**

SCREWDRIVER

WRENCH, open-end, $1\frac{1}{3}_2$ -in.

c. **Removal.**

(1) Remove the 2 mounting nuts and locks by holding a $1\frac{1}{3}_2$ -inch open-end wrench on the nuts while turning the mounting screws (screwdriver) on the face of the instrument panel. Lift the breaker off the mounting screws.

(2) Remove the 2 terminal post screws (screwdriver) and disconnect the black wire from the top post and the black and orange leads at the bottom terminal.

d. **Installation.** Tools as listed in subparagraph b above.

With the circuit breaker in position to be mounted with its slotted opening to the bottom, install the black wire to the top post and the black and orange leads to the bottom terminal. Complete the installation by reversing the removal directions.

123. WINDSHIELD WIPER AND SWITCH.

a. **Description.** The electric windshield wiper system consists of a single speed motor and arm assembly mounted at the middle of the windshield upper frame, a cable from the motor to the panel socket at the upper left corner of the instrument panel (A, fig. 105) and a push-pull control switch (B, fig. 105).

b. **Wiper Removal.**

SCREWDRIVER

WRENCH, open-end, $\frac{5}{8}$ -in.

(1) Remove the cable at the motor by pulling the wire terminal end out of the forward junction post on the motor.

(2) Loosen the wiper arm assembly fastening screw (screwdriver) located near the top of the wiper arm. Pull the arm out and upward to remove it from the wiper shaft. Remove the motor shaft end nut (screwdriver) and pull off the spacer. Remove the shaft housing nut ($\frac{5}{8}$ -in. open-end wrench) and pull the wiper motor away from its mounting on the windshield frame. (The removal procedure for the hand wiper is similar to that for the electric wiper except that no shaft housing nut is used.)

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c. Wiper Installation. Tools as listed in paragraph 123 b.

Reverse the procedure given for removal. On completing the installation, operate the wiper to check the blade travel and reposition the wiper arm on the motor shaft as required to give equal blade travel on the windshield surface.

d. Switch Removal.

SCREWDRIVER

WRENCH, box, $\frac{1}{16}$ -in.

SCREWDRIVER, small
instrument

(1) Disconnect the battery ground strap (par. 55 n).

(2) Loosen the 2 terminal post screws (screwdriver) on the back of the switch body and remove the orange wire connected to the right post and the black wire on the left terminal.

(3) Loosen the switch button set screw (small instrument screwdriver) and turn the button counterclockwise to remove it from the switch operating shaft. Remove the lock nut ($\frac{1}{16}$ -in. box wrench) holding the switch body to the instrument panel. Remove the switch from the panel, noting the use of a star washer between the switch body and rear side of the instrument panel.

e. Switch Installation. Tools as listed in paragraph 123 d.

The wiper control switch is installed by reversing the removal directions. Make sure a star washer is installed between the switch body and back of the panel. The orange wire must be connected to the switch right terminal post and the black wire to the left post. Turn the switch button clockwise on the operating shaft until tight, then turn it until the identification name is horizontal and tighten the button set screw.

f. Wiper Panel Socket Removal.

SCREWDRIVER

(1) Disconnect the motor wire at the socket on the instrument panel by turning the wire clip counterclockwise and pulling it out of the socket. Loosen the wiper switch left post screw (screwdriver) and disconnect the black wire.

(2) Remove the 2 socket mounting screws (screwdriver) and pull the socket off the instrument panel.

g. Wiper Panel Socket Installation. Tools as listed in paragraph 123 f.

(1) Reverse the removal procedure, making sure the black wire is connected to the wiper switch left terminal post.

124. WINDSHIELD DEFROSTER SHIELD SWITCH.

a. **Windshield Defroster Shield.** This unit functions to heat a section of the windshield glass so that the driver's vision is not totally obstructed by frost, frozen snow, or ice formations on the windshield.

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The electric element type defroster with connecting wires and adhesive fluid is contained in a metal box that permits satisfactory storage in the vehicle when not installed on the windshield. The defroster is operated by a switch located on the right side of the instrument panel.

(1) WINDSHIELD DEFROSTER SHIELD INSTALLATION.

(a) Clean the rear side (the glass surface within the driver's compartment) of the windshield.

(b) Loosen the 4 suction cup to frame thumb nuts on the defroster unit so that the bottom of the suction cups will be flat. Cover the flat surface of the suction cups with adhesive fluid taken from the tube furnished. Hold the defroster with the wire terminals to the right, on the rear side of the windshield, and allow at least 1-inch clearance between the top edge of the defroster frame and the hand windshield wiper control when at its lowest point of travel. Press the defroster firmly against the windshield and tighten the 4 suction cup to frame thumb nuts, pressing each cup firmly against the glass to create a vacuum and seal the defroster to the windshield (fig. 108).

(c) Loosen the defroster switch terminal post screw (screwdriver) on the left side and at the back of the switch, also the terminal screw on the lower back face of the switch. Run the defroster wires to the right side of the instrument panel, insert the wire ends having spade terminals under the switch terminal screws, and tighten the screws (J, fig. 105).

(2) WINDSHIELD DEFROSTER SHIELD REMOVAL.

(a) The defroster is removed by disconnecting the wires at the control switch, loosening the suction cup to frame screws, and squeezing the cups while pulling them off the windshield glass.

b. Windshield Defroster Shield Switch.

(1) SWITCH REMOVAL.

SCREWDRIVER

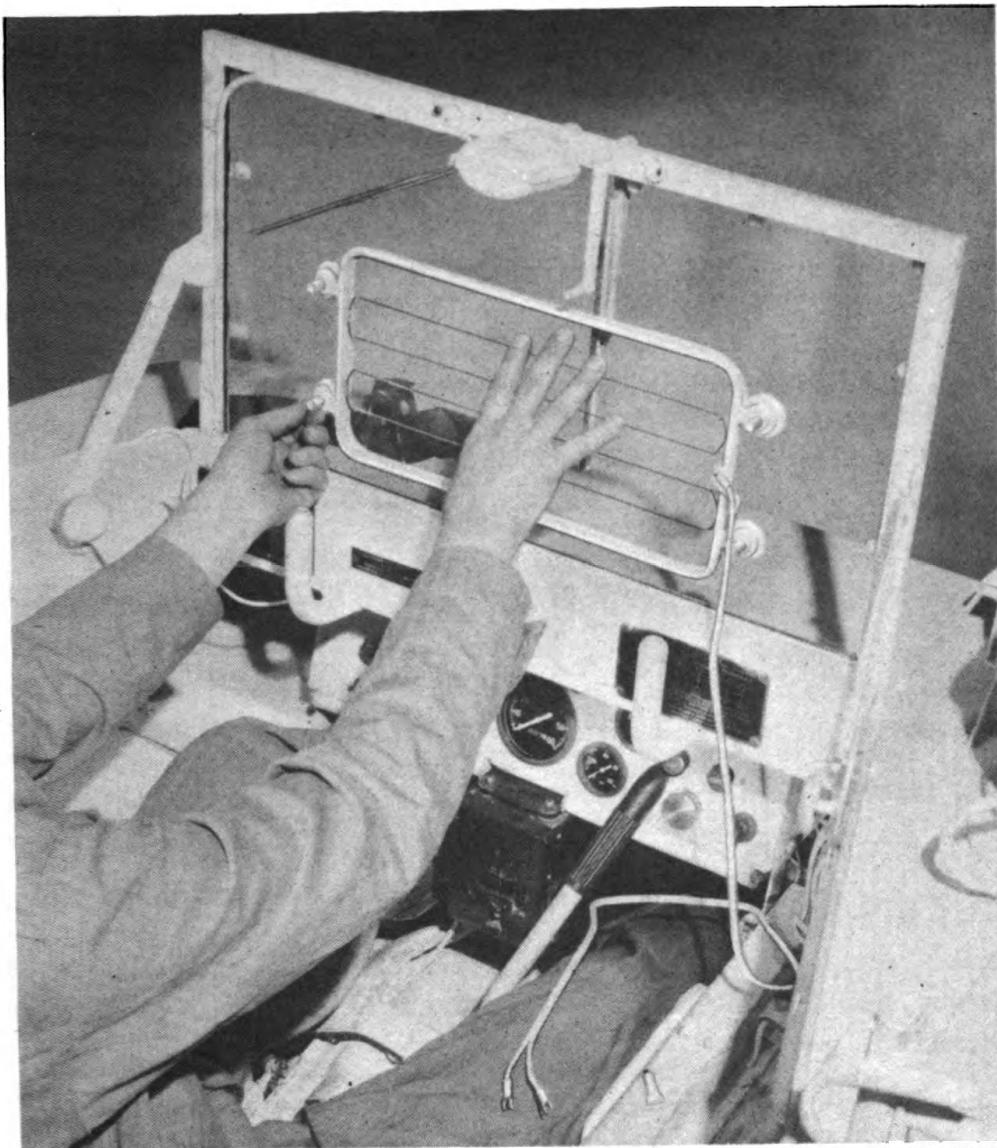
WRENCH, box, $\frac{9}{16}$ -in.

SCREWDRIVER, small instrument

(a) To remove the windshield defroster shield switch located on the right side of the instrument panel (J, fig. 105), loosen the 2 terminal post screws (screwdriver) on the back of the switch body. Pull off the spade terminal wire ends from each post, noting that the wire connected to the switch left post runs to the bottom post on the ignition switch and is fused (10-ampere fuse with insulator).

(b) Loosen the switch button set screw (small instrument screwdriver) and turn the button counterclockwise off the switch operating shaft. Remove the lock nut ($\frac{9}{16}$ -in. box wrench) that holds the switch body to the instrument panel. Push the switch out the back of the panel,

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Figure 108—Windshield Defroster Shield Installation

noting that an angle plate is used between the switch body and rear side of the panel for attachment of the windshield defroster ground wire.

c. Switch Installation. Tools as listed in paragraph 124 b.

(1) Reverse the steps followed for removal, making sure the angle plate for grounding is installed between the switch body and rear side of the panel. Connect the windshield defroster wires, the black one running from the ignition switch to the defroster switch left terminal post. Install the switch button by turning it clockwise on the operating shaft until tight, then turn the button until the identification name is horizontal and tighten the button set screw.

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125. HEAT INDICATOR (ENGINE TEMPERATURE) GAGE.

a. **Description.** The heat indicator (engine cooling system temperature) gage is located near the center of the instrument panel and may be viewed at a glance by the driver (R, fig. 105). The gage range is from 100 to 220 Fahrenheit. The instrument hand and graduation figures have a luminous coating which permits observation of the gage in darkness.

b. Equipment.

SCREWDRIVER	WRENCH, open-end, $\frac{7}{16}$ -in.
WRENCH, open-end, $\frac{3}{8}$ -in.	WRENCH, open-end, $\frac{5}{8}$ -in.

c. Removal.

(1) Open the engine compartment lid, turn the sealing radiator cap to its half-open position, remove the cooling system drain plug (screwdriver) on the bottom of the hull, and open the radiator drain valve at the radiator lower pipe to drain the system. Close the drain valve and install the drain plug.

(2) At the engine cylinder head just back of the oil filler neck, disconnect the heater element of the gage ($\frac{5}{8}$ -in. open-end wrench). Unfasten the clip which holds the flexible gage tube to the main wiring harness.

(3) Loosen the 4 screws (screwdriver) on the left side of the 2 conduits (control lines covers) and the 4 nuts ($\frac{7}{16}$ -in. open-end wrench) on the studs on the right side of the conduits. Lift the covers sufficiently to expose the flexible heat indicator tube.

(4) At the back of the gage, remove the 2 nuts ($\frac{3}{8}$ -in. open-end wrench) and locks at the clamp bracket. Pull the gage out the panel face opening, also drawing the flexible tube and element through the clamp bracket and plane hole.

d. Installation. Tools as listed in subparagraph b above.

LEAD, white, basic-carbonate

Install the gage with flexible tube and element by reversing the removal steps. There must not be any sharp bends in the tube and care must be exercised during installation not to crimp the tube. The tube must be coiled before the element enters the cylinder head. The coil serves as a vibration damper. Coat the threads of the element with LEAD, white, basic-carbonate, before installing it in the cylinder head. Before checking the gage operation with the engine running, be sure to fill the radiator with coolant. Inspect for possible leakage where the element is installed at the cylinder head.

126. OIL PRESSURE GAGE.

a. **Description.** The engine oil pressure gage is located near the middle of the instrument panel within quick glance vision of the driver

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(Q, fig. 105). The pressure range of the gage is from 0 to 80 pounds and the instrument registers whenever the engine is operating.

b. Equipment.

WRENCH, open-end, $\frac{3}{8}$ -in.

WRENCH, open-end, $\frac{9}{16}$ -in.

c. Removal.

(1) Loosen the oil pressure line fitting ($\frac{9}{16}$ -in. open-end wrench) on the back of the gage and bend the line out of the way.

(2) Remove the 2 nuts ($\frac{3}{8}$ -in. open-end wrench) and locks from the studs on the gage and pull the gage out the instrument panel face opening.

d. Installation. Tools as listed in paragraph 126 b.

Reverse the removal procedure, making certain a tight connection is obtained at the gage line fitting. Operate the engine to check the gage and inspect for leakage at the gage line fittings.

127. SPEEDOMETER.

a. **Description.** The speedometer is located in the middle of the instrument panel just below the line of the driver's straight ahead vision (G, fig. 105). The speedometer hand and the 10 and 20 graduation figures have a luminous coating which permits observation of the instrument in darkness. The speedometer has a 0 to 60-miles-per-hour range. An odometer registering total vehicle mileage is integral with the speedometer unit, as is a trip mileage recorder. The trip mileage reading may be cleared by turning a thumb screw on the back of the speedometer unit.

b. Equipment.

PLIERS

c. Removal.

Loosen the speedometer drive cable to instrument body coupling nut (pliers). Remove the 2 wing nuts and lock washers on the speedometer clamp studs which hold the fastening bracket to the back of the panel. Pull the bracket off the studs and lift the speedometer head out the panel mounting holes. The speedometer cable is removed by disconnecting the cable at the instrument body coupling nut (pliers) and the cable coupling nut at the axle unit.

d. Installation. Tools as listed in subparagraph b above.

Reverse the steps outlined in removal when installing the speedometer unit or cable.

128. CARBURETOR CHOKE CONTROL.

a. **Description.** To facilitate starting the engine when cold, a carburetor choke valve control is provided. The carburetor choke control is mounted on the instrument panel and is readily accessible to the driver's

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right hand (K, fig. 105). Pulling the choke control button outward shuts off the air to the carburetor to provide a richer mixture. As soon as the engine starts to operate uniformly, gradually open the choke valve by pushing in on the choke control button to prevent overchoking (par. 8).

b. Equipment.

SCREWDRIVER

WRENCH, open-end, $\frac{9}{16}$ -in.

WRENCH, open-end, $\frac{7}{16}$ -in.

c. Removal.

(1) Loosen the choke linkage to control wire collar screw (screwdriver) on the carburetor choke valve operating linkage, also the screw securing the choke control flexible cable to the choke linkage bracket on the carburetor.

(2) Remove the fire extinguisher. Remove the screw, lock washer, and nut ($\frac{7}{16}$ -in. open-end wrench and screwdriver) securing the choke control flexible cable clip to the bulkhead. Open the clip and remove it from the cable.

(3) The carburetor choke control cable is carried in the conduit or channel on the right hand shelf within the cockpit. To expose the cable, remove 4 nuts, lock washers, and flat washers, ($\frac{7}{16}$ -in. open-end wrench) on the right side and 4 screws (screwdriver), locks, and flats from the left side of the cable conduit. Lift off the conduit which is in two sections.

(4) Remove the nut and lock ($\frac{9}{16}$ -in. open-end wrench) that secures the choke control sleeve to the back of the instrument panel.

(5) Pull the control cable assembly out the mounting hole in the instrument panel through the nut and lock.

d. Installation. Tools as listed in subparagraph b above.

To replace the carburetor choke control, insert the cable through the hole in the panel and through the lock and nut, with the lock and nut held in position on the back side of the panel. The flat located on the choke control sleeve must register with the flat in the panel mounting hole. Complete the installation by reversing the removal procedure.

e. Adjustment. Check the choke for proper operation. Loosen the choke linkage to control wire collar (screwdriver) at the carburetor choke linkage. Push the choke control button in as far as it will go against the instrument panel. Hold the choke valve and lever assembly in the fully open position and tighten the control wire collar screw on the choke linkage, also the screw securing the choke wire cable to the linkage bracket on the carburetor.

129. CARBURETOR THROTTLE CONTROL.

a. Description. The carburetor throttle control button on the instrument panel is readily accessible to the driver's right hand (L, fig. 105). It is connected to the foot accelerator pedal upper control arm by a

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flexible cable and wire. Pulling the throttle control button outward increases the speed of the engine. It is used when starting the engine and to maintain a constant engine speed during the warming up period.

b. Equipment.

SCREWDRIVER

WRENCH, open-end, $\frac{9}{16}$ -in.

c. Removal.

(1) Remove the nut and lock ($\frac{9}{16}$ -in. open-end wrench) that secures the throttle control sleeve to the instrument panel.

(2) Loosen the screw (screwdriver) in the throttle control wire retaining collar. Remove the collar from the wire.

(3) Pull the control assembly out the mounting hole in the instrument panel and through the lock and nut.

d. Installation. Tools as listed in subparagraph b above.

Insert the throttle control assembly through the hole in the panel and the lock and nut, with the lock and nut held in position on the back side of the panel. The flat on the throttle control sleeve must register with the flat in the panel mounting hole. Insert the control wire through the accelerator pedal upper control arm. Install the control wire retaining collar over the wire with the round end of the collar toward the arm and tighten the collar screw.

e. Adjustment.

With the throttle control button in as far as it will go against the instrument panel, hold the throttle control wire retaining collar against the accelerator pedal control arm and tighten the retaining collar screw (screwdriver).

130. INSTRUMENT PANEL (fig. 105).

a. Description. The instrument panel is located at the front of the cockpit and is recessed slightly below the front deck to provide protection to the instruments and yet permit ready visibility and accessibility of the controls. The lower edge of the panel is padded for protection to the driver's knees and legs (fig. 105).

b. Equipment.

HANDLE, ratchet

WRENCH, open-end, $\frac{3}{8}$ -in.(2)

PLIERS

WRENCH, open-end, $\frac{7}{16}$ -in.

SCREWDRIVER

WRENCH, open-end, $\frac{9}{16}$ -in.

SOCKET, $\frac{1}{2}$ -in.

c. Removal.

(1) Disconnect the battery ground strap (par. 55 n).

(2) Disconnect the steering lever by removing the cotter pin and clevis pin at each lever (pliers). Move the levers rearward out of the way.

LIGHT CARGO CARRIER T-15

(3) Disconnect the primer inlet pipe at the brass jam nut ($\frac{3}{8}$ -in. and $\frac{7}{16}$ -in. open-end wrenches) and the outlet pipe at the bottom of the pump body ($2\frac{3}{8}$ -in. open-end wrenches). Disconnect the oil pressure gage pipe ($\frac{9}{16}$ -in. open-end wrench). Disconnect the spotlight silver wire on the right terminal of the spotlight switch (screwdriver). Disconnect the electric windshield wiper at the instrument panel socket. Disconnect the carburetor throttle control wire at the accelerator pedal control arm (screwdriver).

(4) Remove the bolt ($\frac{7}{16}$ -in. open-end wrench), spacer, and nut ($\frac{7}{16}$ -in. open-end wrench) fastening the compass mounting bracket to the bracket to hull brace. Remove the 2 cap screws, flat washers, lock washers, and nuts holding the panel to the upper support brackets ($\frac{1}{2}$ -in. socket, and ratchet handle). Remove the 2 cap screws ($\frac{1}{2}$ -in. socket, and ratchet handle), lock washers, and nuts that secure each side of the panel to mounting brackets, noting that the wiring harness clip bracket is held by the upper right panel screw and the axle unit ventilator pipe clip by the lower left panel screw. Also, note that the front bomb case wire tubing is clipped at the panel lower mounting bolts at each side.

(5) Pull the panel out and down as limited by the instruments, control lines, and compass. If necessary, remove the compass and mounting bracket assembly (par. 133 b (3)). To remove the panel from the vehicle, disconnect all wires and lines as directed under the paragraphs covering each of the instruments and controls.

c. Installation. Tools as listed in subparagraph b above.

The instrument panel is installed by reversing the removal procedure. No special instructions are needed other than to make sure the primer and oil gage pipes are connected securely and all wires are connected to their proper terminals on the various electrical gages.

131. ELECTRICAL WIRING.

a. The vehicle electrical wiring is contained in a main harness and two auxiliary wiring systems. The main harness connects the controls and gages on the instrument panel with the related units in the engine compartment and is carried in the conduit or channel on the right-hand shelf within the cockpit. One auxiliary harness carries wires which connect the generator to the current and voltage regulator. The other harness contains wires connecting the regulator with the large filter mounted on the front side of the engine compartment right forward wall. No special servicing instructions are required in connection with the electrical wiring; however, it is important that all terminals and connections be kept tight to prevent faulty operation of the vehicle and units, electrical shorts, and radio interference (fig. 109).

INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES

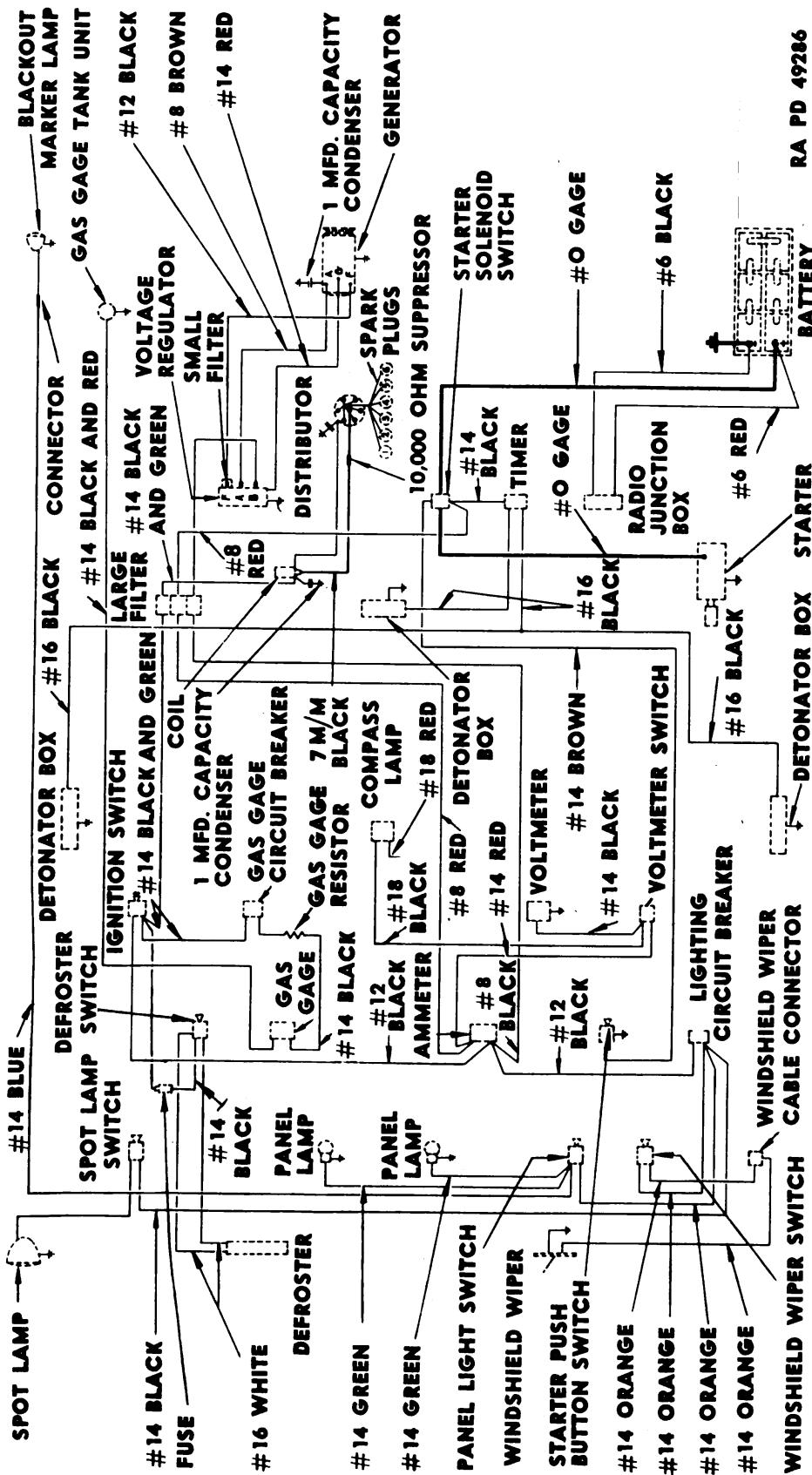


Figure 109—Wiring Diagram

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132. RADIO INTERFERENCE SUPPRESSION.

a. In order to eliminate interference with the radio equipment, the electrical units of the vehicle are fully suppressed. Suppressors are used on the spark plug wires at the plugs. Also, a suppressor is used on the secondary wire between the coil and distributor at the distributor. The generator charging circuit, the ignition circuit, and ammeter leads are equipped with interference filters. These filters are mounted in a group on the front side of the engine compartment right forward wall. Condensers are located at the switch side of the ignition coil and at the armature terminal of the generator. In order to provide adequate grounding, the current and voltage regulator, ignition coil, large group filter, and the radio terminal box are mounted with internal and external tooth washers between the mounting points of the units and the surfaces to which they are mounted. Inasmuch as these units require definite grounding, the washers must be used and the mounting bolts kept tight at all times.

b. Radio interference characterized by a clicking sound in time with engine speed may be due to any one or several causes. The difficulty may arise from faulty ignition system units or wiring. A cracked distributor cap or one with burned terminals will contribute to radio noise. If this is found to be the case, the cap must be replaced. The same is true of the distributor rotor in that any evidence of a crack or burned electrodes dictates replacement of the rotor. In order to eliminate radio interference of this type, the check must also include a careful examination of the wiring insulation. A complete replacement of wires having broken or leaking insulation must be made. A spark plug with cracked porcelain or burned electrodes will contribute to radio interference and must be replaced. If the ignition coil is at fault, as determined by a substituting one known to be satisfactory, it must be replaced. Replace any parts such as filters, condensers, or suppressors which prove to be at fault. At the time of a general vehicle inspection, all grounds must be checked and tightened securely and any defective parts must be replaced.

c. If radio interference is detected as a rhythmic whine in time with engine speed, its origin is in the generator charging circuit which includes the regulator and ammeter with associated wiring as well as the generator. The condition may result from faulty units in the system or from a discharged battery. The small condenser mounted on the generator must be checked by replacement in case of interference having this characteristic. Determine the condition of the battery by test and, if necessary, install a fully charged battery. If the condition is not eliminated, check the large filter group by replacement.

d. The current and voltage regulator may be responsible for a radio interference condition in which the sound is intermittent and not timed

INSTRUMENTS, WIRING, AND ELECTRICAL ACCESSORIES

with or affected by engine speed. A regulator noise may result if the regulator to bulkhead bolts are loose or if the small filter which is mounted as a part of the regulator is shorted or open. To remedy the condition, tighten the regulator mounting bolts and replace the filter as necessary. If the condition is not eliminated, the regulator must be replaced.

e. For satisfactory radio operation, all connections in the electrical and ignition circuits must be kept clean and tight. In addition, it is important that all mounting bolts for the engine compartment lid be kept tight and the lid latched.

133. COMPASS.

a. The compass and compensators are suspended through four rubber shock mounts to a compass mounting bracket which, in turn, is secured to the instrument panel with a support bracket and a brace from the support bracket to the hull. The compass is located immediately below and slightly to the rear of the instrument panel face, and it is easily visible at a downward glance by the driver. A small light illuminates the compass from within and is wired to the voltmeter switch so that the light burns only when the switch is operated to close the voltmeter circuit. The instrument indicator is sealed in fluid and will operate up to 15 degrees off the horizontal. Exercise care to avoid striking and breaking the glass face of the sealed indicator.

b. A cloth bag attached to the compass contains a compass accessory kit, with directions and parts required to compensate the instrument after installation and in the region the vehicle is to be operated. Compensation of the compass and repairs will be handled by ordnance personnel.

c. The entire compass and mounting bracket assembly is removed and installed as follows:

(1) EQUIPMENT.

HANDLE, ratchet

WRENCH, open-end, $\frac{3}{8}$ -in.

SCREWDRIVER

WRENCH, open-end, $\frac{7}{16}$ -in.

WRENCH, box, $\frac{7}{16}$ -in.

WRENCH, socket, $\frac{7}{16}$ -in.

(2) PROCEDURE.

(a) Remove the 4 screws (screwdriver) on each side which hold the left and right side plates to the compass case.

(b) Disconnect the compass light wires by removing the black wire from the lower voltmeter switch terminal (screwdriver) and the red wire from the left voltmeter mounting stud ($\frac{3}{8}$ -in. open-end wrench).

(c) Remove the compass mounting bracket to hull brace bolt, nut, and spacer at the compass bracket ($\frac{7}{16}$ -in. box wrench and a $\frac{7}{16}$ -in. open-end wrench).

LIGHT CARGO CARRIER T-15

(d) Remove the 2 rear nuts ($\frac{7}{16}$ -in. socket wrench) with lock and loosen the forward 2 nuts and locks that secure the compass mounting bracket to the instrument panel support bracket. The forward nuts should then be removed with the fingers while the entire assembly is held with the other hand.

(e) Reverse the removal procedure when installing the compass and mounting bracket assembly.

(3) The compass is removed and installed as follows:

(a) With a screwdriver, take out the 4 screws fastening the left side plate to the case and remove the plate.

(b) While holding the compass unit with the left hand, remove the 4 screws (screwdriver) on the face which secure the compass to the case.

(c) Move the compass forward so that the projection on the rear of the unit enters the hole in the mounting bracket. Then lift the compass out through the side of the case.

(d) To install the sealed compass in the case, reverse the steps given for removal.

Section XXII

DEMOLITION EQUIPMENT

	Paragraph
General description	134
Bomb cases	135
Timer control	136
Detonator container	137
Operating instructions	138

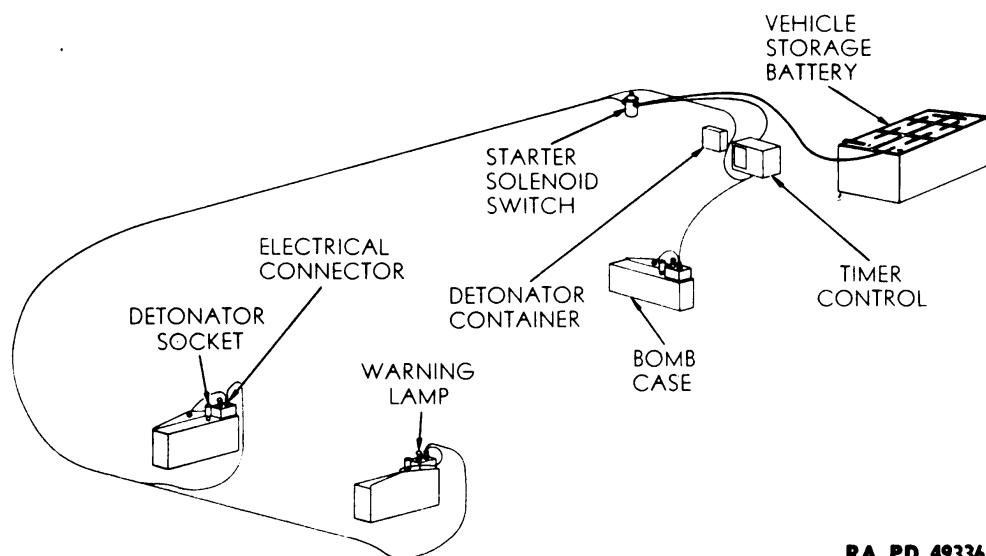
134. GENERAL DESCRIPTION.

a. Demolition equipment is provided to demolish the vehicle in the event it becomes necessary to abandon it while in a combat zone. The equipment consists of a timer control switch, three bomb cases, detonators carried in a container, and an electric circuit for discharging the bombs (fig. 110).

135. BOMB CASES.

a. Description.

The three bomb cases, each having a capacity of three pounds of TNT, are welded in position; one being located on the forward face of the bulkhead directly behind the assistant driver's seat; one on the inner wall of the hull at the right of the driver's seat; and one on the left of the driver's seat. Mounted on each bomb case cover is a warning light, detonator socket, and an electrical wiring connector.



RA PD 49336

Figure 110—Demolition Equipment and Wiring

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b. Removal.

The bomb cases are welded in position and are not removable; however, the covers can be readily removed by lifting upward to permit the installation of the TNT charges.

136. TIMER CONTROL

a. Description.

The timer control consists of a device to discharge the bombs 5 minutes after it is placed in operation by breaking the glass face of the timer control case and removing the red timer control pin. The timer control case is mounted on the left forward face of the bulkhead and is readily accessible to the assistant driver.

b. Equipment.

EXTENSION, socket

SOCKET, $\frac{7}{16}$ -in.

HANDLE, ratchet

c. Removal.

From the rear face of the bulkhead, remove the 2 nuts ($\frac{7}{16}$ -in. socket extension, and ratchet handle), lock washers, and flat washers securing the timer control case to the forward face of the bulkhead. Disconnect the timer control to bomb case wires at the socket in the bottom of the timer control case by turning the wire connector clockwise. Then pull the timer control with studs forward and off the bulkhead.

d. Installation. Tools as listed in subparagraph b above.

Reverse the removal procedure when reinstalling the timer control.

137. DETONATOR CONTAINER.

a. Description.

The bomb detonators are carried in a metal case mounted on the forward face of the bulkhead to the right of the timer control. The container is readily accessible to the assistant driver.

b. Equipment.

EXTENSION, socket

SOCKET, $\frac{7}{16}$ -in.

HANDLE, ratchet

WRENCH, open-end, $\frac{7}{16}$ -in.

c. Removal.

Remove the detonator case cover. Using a $\frac{7}{16}$ -inch socket extension, ratchet handle, and a $\frac{7}{16}$ -inch open-end wrench, remove the 2 bolts, nuts, lock washers, and flat washers securing the case to the forward face of the bulkhead.

d. Installation. Tools as listed in subparagraph b above.

Reverse the removal procedure.

DEMOLITION EQUIPMENT

138. OPERATING INSTRUCTIONS.

a. Before inserting the detonators in the bomb cases be absolutely certain that the *warning light mounted on each bomb case is not lighted*. The warning light indicates that the circuit through the timer control and bomb cases is completed, and the bombs will become immediately active if they contain a charge and if the detonators and electrical connections are placed in the firing position. *The detonators must not be installed in the bomb cases if the warning lights are lighted*.

b. To Load Bombs.

At each case, if not loaded previously, lift off the bomb case cover and install three 1-pound charges of TNT. Replace the cover.

c. To Place Demolition Equipment in Operation.

(1) Lift off the detonator case cover and remove 3 detonators. This operation is best performed by the assistant driver who then passes 2 detonators to the driver for installation in the forward bombs.

(2) Remove the detonator socket cover from the top of the bomb case cover by turning it counterclockwise and lifting upward. Insert a detonator in the socket.

(3) Remove the electrical connector with wire from the light circuit socket on the bomb case cover by turning it counterclockwise and lifting upward.

(4) Install the electrical connector on the detonator socket, press the connector downward, and turn it clockwise.

(5) Break the glass face of the timer control case using the butt of a revolver or any suitable tool or piece of equipment. Pull the red timer control pin outward and completely out of the timer control case. Removal of the red timer control pin places the timer in operation. Five minutes will elapse before the contact points within the timer close to complete the electrical circuit and discharge the bombs.

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Section XXIII

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139. STANDARD NOMENCLATURE LISTS.	
a. Ammunition.	
Ammunition, revolver, automatic pistol, and sub-machine guns	SNL T-2
Ammunition, rifle, carbine, and automatic gun	SNL T-1
b. Armament.	
Carbine, cal. .30, M1 and M1A1	SNL B-28
Gun, submachine, cal. .45, Thompson, M1928A1 and M1	SNL A-32
Launcher, rocket, AT, M1 (antitank)	SNL B-36
Rifle, automatic, cal. .30, Browning, M1918, M1918A1, and M1918A2	SNL A-4
c. Carrier, light cargo, T-15 (Studebaker)	SNL G-154
d. Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items	SNL K-1
Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained in the "Ordnance Publications for Supply Index"	OPSI

140. EXPLANATORY PUBLICATIONS.

a. Armament.	
Browning automatic rifle, cal. .30, all types	TM 9-1211
Launcher, rocket, AT, M1	TM 9-294
Thompson submachine gun, cal. .45, M1928A1	FM 23-40
Thompson submachine gun, cal. .45, M1928A1	TM 9-1215
U. S. carbine, cal. .30, M1	FM 23-7
b. Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
c. Communications.	
Radio fundamentals	TM 11-455
Radio set SCR-506	TM 11-630
Radio sets SCR-508, SCR-528, and SCR-538	TM 11-600
The radio operator	TM 11-454

REFERENCES

d. Maintenance and Inspection.

Echelon system of maintenance	TM 10-525
Fire prevention, safety precautions, accidents	TM 10-360
Motor transport inspections	TM 10-545
Sheet metal work, body, fender, and radiator repairs	TM 10-450

e. Miscellaneous.

Automotive electricity	TM 10-580
Automotive lubrication	TM 10-540
Camouflage	FM 5-20
Defense against chemical attack	FM 21-40
Electrical fundamentals	TM 1-455
Fuels and carburetion	TM 10-550
Motor transport	FM 25-10

f. Storage and Shipment.

Storage of motor vehicle equipment	AR 30-1055
Storage of motor vehicle equipment	AR 850-18

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[A.G. 062.11 (2-5-43)
O.O. 461/1086 O.O. (2-9-43)]

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G. C. MARSHALL,
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